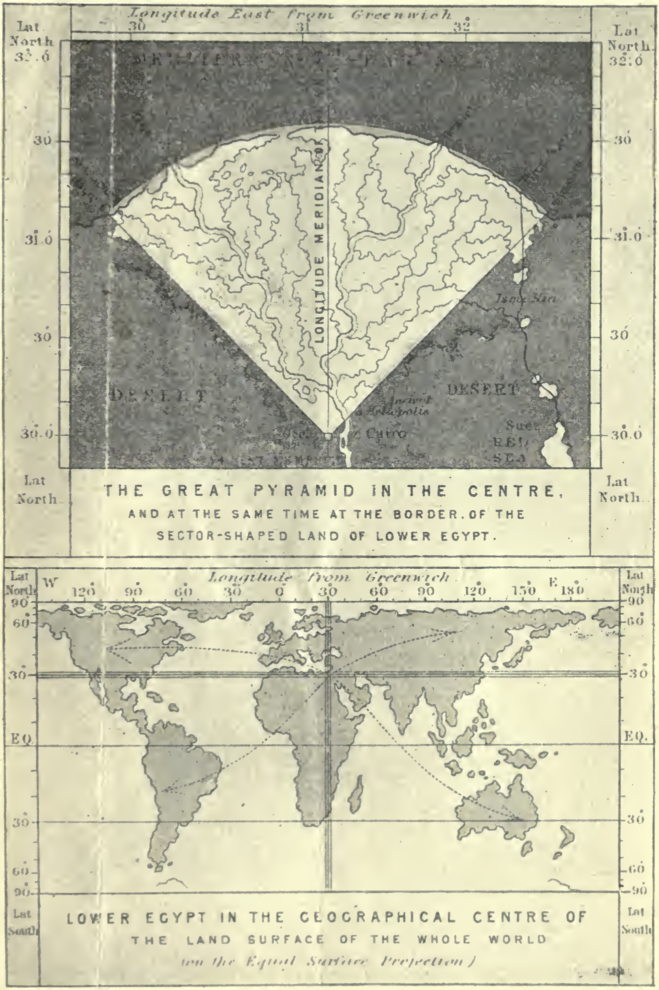
PLATE II AS IT APPEARS IN THIS WORK



THE GREAT PYRAMID IN THE CENTRE,
AND AT THE SAME TIME AT THE BORDER. OF THE
SECTOR-SHAPED LAND OF LOWER EGYPT.

LOWER EGYPT IN THE GEOGRAPHICAL CENTRE OF
THE LAND SURFACE OF THE WHOLE WORLD
(on the Equal Surface Projection)

The above plate shows the geography of Upper Egypt, with the different mouths of the Nile river as it enters the Mediterranean Sea, from the sector-shaped land showing the line of the Great Pyramid to be placed in the exact center. Also the map of the world on the "Mercator projection," showing the Great Pyramid to be located near the center of all the land of the earth, and at the exact center of its weight above water.

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To Antiquarians, Egyptologists, and Pyramidal Students, together with the Scientific, Astronomical, Mathematical and Fraternal Public, Greeting:

THE

GREAT PYRAMID JEEZEH

FOR WHAT PURPOSE WAS IT BUILT?
BY WHOM WAS IT BUILT?
AND ABOUT WHEN WAS IT BUILT?

Satisfactorily answered in this work of 588 pages, containing twenty full page illustrations on the finest of paper, in new 10 point type. The printed page is 3⅝ inches wide by 6⅛ inches long; the binding is full gilt, in red cloth and red leather.

Every fraternal organization, whithersoever dispersed, will be interested in the contents of this work, as it undertakes to show the origin of all fraternities.

The Subject of the Great Pyramid

has been a life study of the author, and for over thirty-five years has occupied all of his spare moments. For the ability to prepare this work, his researches have extended to nearly every printed authority on the subject, presented in the last two thousand years.

The theory of the purpose for which it was built, when it was built, and by whom, is original with the author, and should add a new phase to the pages of history.

A Few Lines on the Theory of the Author

"It was built for an **Initiatory Asylum**, and **Depository of Weights and Measures**, by a race of people that preceded our race, or any of the races now in existence, on the face of the earth. And that over 50,000 years have elapsed since its erection. The race of people that built the first pyramid were swept away by the **Last Cataclysm.**

"In the building of this 'First Great Wonder of the World' they exhibited a knowledge so much superior to the wisest of our present population that a comparison can scarcely be made between the extremes of intelligence and ignorance on the face of our globe today. Nor will we **attain** as a race to their standard of scientific knowledge until such time has elapsed as will equal the past genealogy of this lost race, which was most certainly thousands of years."

There is Only One Pyramid

"All others are mere imitations, the erection of which any ordinary mechanic could superintend."

The Measurements of the Great Pyramid, as used in this work, are corroborated by the eminent authors of the past on Egyptology and pyramidal building.

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Under the Astronomical section a new theory for the sun's heat is offered, and corroborative evidence induced to prove that the **sun is cold** and covered with snow, the sequel for the cause of "**sun spots.**"

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THE
Great Pyramid Jeezeh

BY

Louis P. McCarty

Author of the "Statistician and Economist," "Health, Happiness and Longevity," Etc.

* * * * * * * to "know
That which before us lies in daily life,
Is the prime wisdom; What is more, is fume,
Or emptiness, or fond impertinence;
And renders us, in things that most concern,
Unpractised, unprepared, and still to seek."
— Milton's Adam to Angel.

SAN FRANCISCO
Louis P. McCarty
1907

The Great Pyramid Jeezeh

For What Purpose Was it Built?

By Whom Was it Built?

And About When Was it Built?

Satisfactorily answered in the following pages.

In the pages that follow, many other subjects are treated with copious notes from different authors, but all are of interest to prove our theory.

PRICE

In Cloth...........$5.00 In Leather...........$6.00

PREFACE

"Wer Vieles bringt, wird Jedem etwas bringen."
(Who brings many things, brings something for each.)
Goethe.

NEARLY every thinking human being has some secondary subject, outside of his regular calling, upon which he devotes his spare moments.

With some, it consists in attempting to solve the hidden mysteries of the future life, through the agency of some one of the eleven hundred different faiths, as to who, or what, is Deity.

With others, the mineralogical fields are explored, with the expectation of finding the original atom of matter, without combination, with side issues of all other "isms" and "ologies" that exist.

The astronomer delights in his calling, peering into space, and every now and then astounds us with the discovery of a new world, or one at least, that has passed within the reach of our strongest magnifiers; while the antiquarians and anthropologists are not idle. Through the findings of the students of all the foregoing subjects mentioned, a fair minority of the thinking public are found to be followers. There are, however, a very few people, living in this 20th century, who believe in or agree with the *theories* of any of the (over) one hundred prominent writers of the past, regarding the purpose for which the *Great Pyramid Jeezeh* was built, much less when, or by whom it was built.

Having spent nearly all of our spare moments for the past thirty-five years in studying the works of the principal writers on the subjects of Antiquity, Egyptology, and Pyramidal building, we now present the following pages of fact and theory for the criticism of an intelligent public, the gist of which theory is our own.

The Great Pyramid Jeezeh

For What Purpose Was it Built?

By Whom Was it Built?

And About When Was it Built?

Satisfactorily answered in the following pages.

Belcher

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To present our subject properly, two volumes should precede this; one on the theory of "world building," and the other on "man's advent on the earth."

But life is precarious; we must hurry on, and ask a generous public to accept our theories in a single volume.

We offer no apology, however, for treating so many different contemporaneous subjects in the following pages, for we consider them all necessary to prove our theory.

All we desire of our critical readers to believe is: that the "Great Pyramid Jeezeh" really exists at this time; that it is placed at or near the "geographical center" of all the continents on the face of the earth; and that the measurements as quoted from the principal authorities are approximately correct.

Our theory, then, (that it was built by a race of people that preceded our race, with vastly more intelligence than we now possess, or will possess at the end of the 20th century,) will be susceptible of proof, and much light will be conveyed to our (apparent) mysterious subject, in opposition to the theory of the principal writers, "that it was built by a Deified architect, assisted by Deified workmen in an age of absolute ignorance (as to most things on the face of the earth)."

So much has been written and said about the Pyramids of Egypt, and the principal publications contain so many references to other publications and reports that students of this subject should live next door to one of our largest "reference libraries," or spend a small fortune on a personal collection of books, in order to be able to comprehend the information that they attempt to furnish.

We shall try in this work, however, to reduce that feature to a minimum, and place within this one volume all the information we wish to convey. It is taken for granted, however, that all readers, writers and investigators of the subject before us, the building of the "First Great Pyramid," will accept as *approximately* correct, the measurements of that great structure as verified and accepted by such eminent Egyptologists, astronomers, and mathematicians as: Col. Howard Vyse, Prof. Piazzi Smyth, the French Academicians, Dr. Grant, Prof. John Greaves, Sir John Herschel, Dr. Lepsius, W. Osburn, Mr. James Simpson, Prof. H. L. Smith, Mr. John Taylor, Sir Gardner Wilkinson, and others, thus making the remaining portion of our task approximately light.

More than two hundred eminent mathematicians and astronomers have visited and measured this pyramid since the year 820 A. D.; some of them spending only a day and measuring only a single passageway, while others camped there and worked steadily for months. The net results, however, can be summed up from the figures furnished by the professors above mentioned, which we give you in the body of this work.

No one will attempt to question the perfect sanity of those professional measurers, as to their mathematics; but when you analyze their opinions regarding the date of the building of that structure, critically, you will discover that they had boxed their science, and appealed to "miracle" to help them out. Most of them were devout Christians, and, in their interpretation of the sacred writings, could not permit of any event antedating the year 4004 B.C.

As we differ so widely from the opinions of the above mentioned "noted authors," regarding the purpose for which it was built, and the possible date of its erection, we ask suspension of personal opinion, until the reader has thoroughly investigated our argument brought forward in this work.

A table of contents follows this preface, also a table of illustrations. And at the close of this work will be found a copious index, which the reader is asked to consult on all occasions, when in doubt regarding any subject herein treated. All principal subjects are indexed direct, as well as by subsections treated. Individuals are indexed under their surnames. The whole is respectfully submitted by the author.

ILLUSTRATIONS OF THE GREAT PYRAMID

For minor mathematical illustrations, see index.

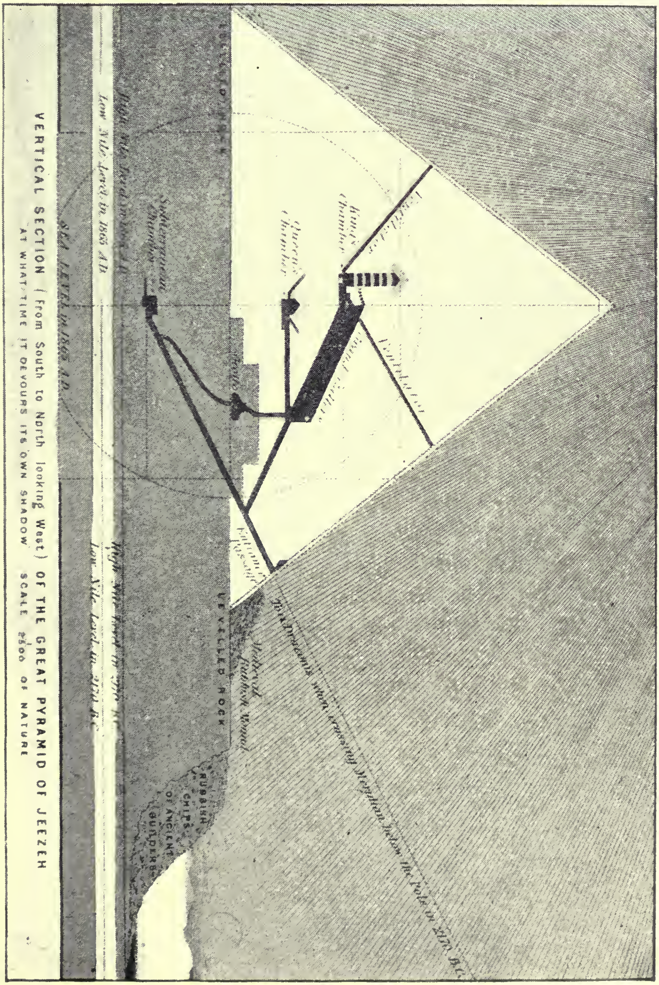
TABLE OF CONTENTS

Illustrations and their explanatory notes extend from page 8 to page 48

See Plate I., opposite page, showing vertical section of the Great Pyramid, from south to north, looking west. At the time of day and season when it devours its own shadow.

The limestone base upon which the pyramid stands is elevated about 146 feet above the average water level surrounding it, and 215 feet above the level of the Mediterranean Sea.

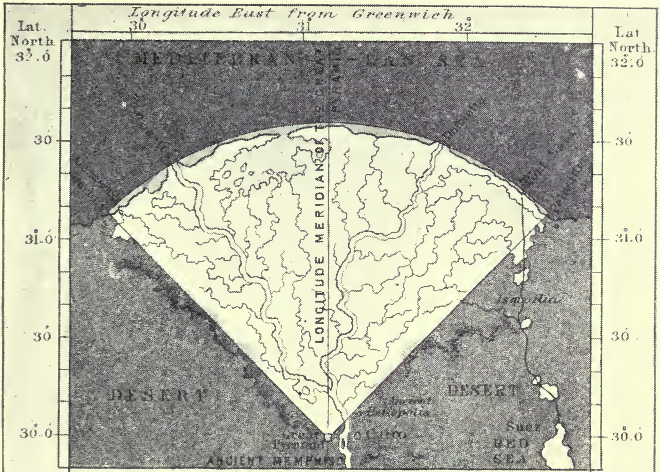
PLATE I



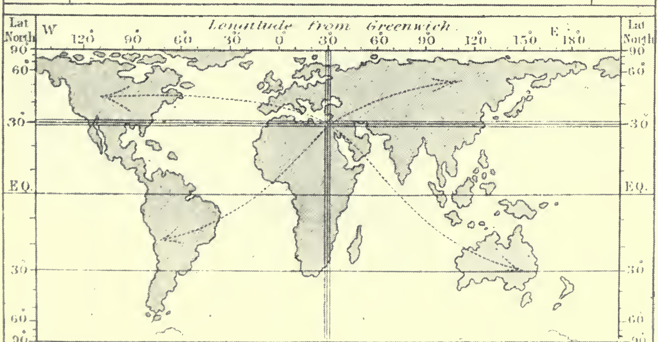
VERTICAL SECTION (from South to North looking West) OF THE GREAT PYRAMID OF JEEZEH
AT WHAT TIME IT DEVOURS ITS OWN SHADOW SCALE 1/2500 OF NATURE

SEE PLATE II. Showing the geography of Upper Egypt, with the different mouths of the Nile river as it enters the Mediterranean Sea, from the sector-shaped land showing the line of the Great Pyramid to be placed in the exact center. Also the map of the world on the "Mercator projection," showing the Great Pyramid to be located near the center of all the land of the earth, and at the exact center of its weight above water.

PLATE II



THE GREAT PYRAMID IN THE CENTRE, AND AT THE SAME TIME AT THE BORDER OF THE SECTOR-SHAPED LAND OF LOWER EGYPT.



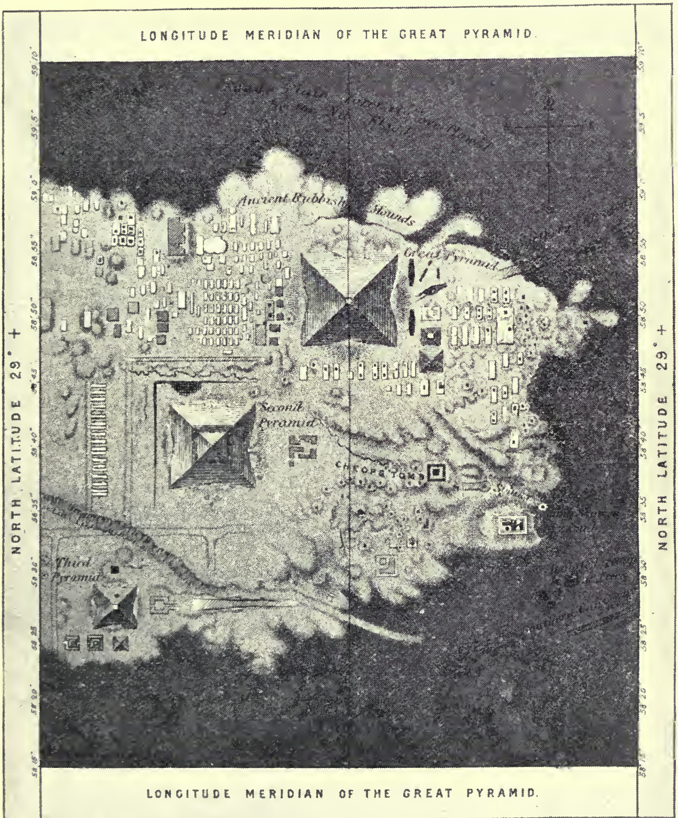
LOWER EGYPT IN THE GEOGRAPHICAL CENTRE OF THE LAND SURFACE OF THE WHOLE WORLD

(on the Equal Surface Projection)

SEE PLATE III. Chorography of the Great Pyramid and its neighbors. Showing also the location of Cheops' tomb, the Great Sphinx, and the relative position of the second and third pyramids.

This is known as the flat-topped hill of Jeezeh. The Great Pyramid is represented in the center near the top of the illustration.

PLATE III



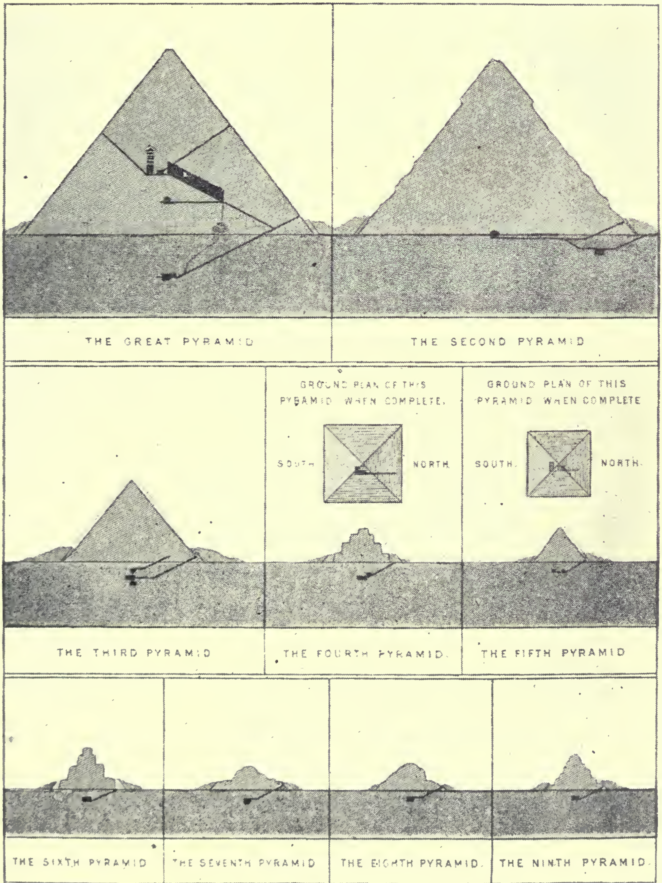
SCALE $\frac{1}{16000}$ NEARLY.

MAP OF THE PYRAMIDS OF JEEZEH, ON THEIR FLAT TOPPED HILL OF ROCK, RISING JUST SOUTH OF THE LOW DELTA LAND OF LOWER EGYPT, AND WEST OF THE NORTHERN END OF THE SINGLE LONGITUDINAL VALLEY, BY WHICH THE NILE BRINGS ITS WATERS THROUGH 36° OF LATITUDE, FROM THE EQUATORIAL LAKES.

See Plate IV. Showing the vertical sections of all the (9) Jeezeh group of pyramids. Their ancient size and shape being shown by the dotted triangles over them.

The only one of this group that was built (outside of the Great Pyramid itself) with any order as to its sloping sides, was the *third*, which see.

PLATE IV



ALL THE PYRAMIDS OF JEEZEH IN VERTICAL AND MERIDIAN SECTION.

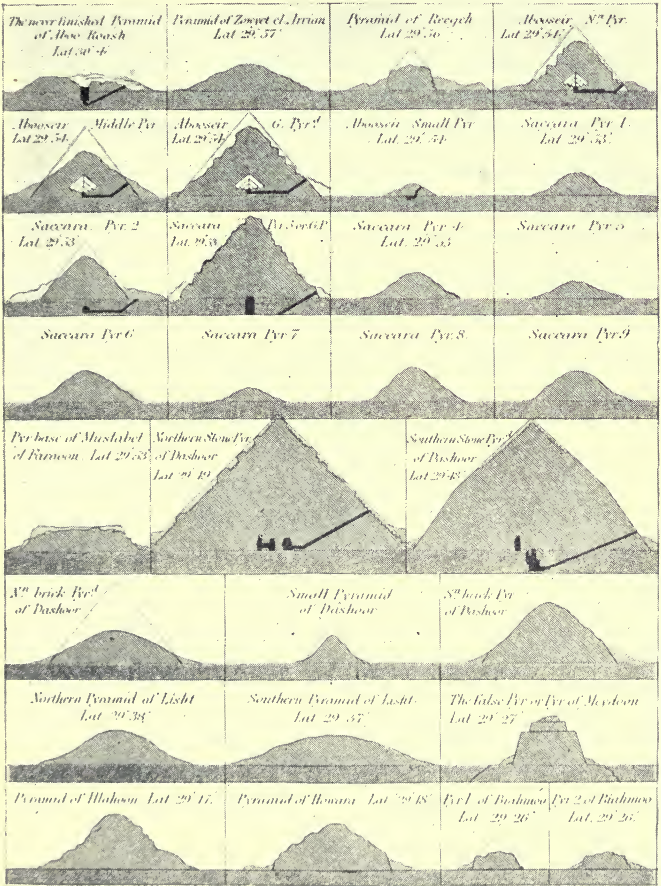
THEIR ANCIENT SIZE AND SHAPE BEING SHOWN BY THE DOTTED TRIANGLES OVER THEM.

Scale $\frac{1}{2000}$ of Nature.

SEE PLATE V. Showing all the pyramids of Egypt outside of the Jeezeh group. This illustration represents them in the order as they will be found passing from north to south, together with their location by latitude.

For their height and date of erection, see table of Pyramids of Egypt, in index.

PLATE V

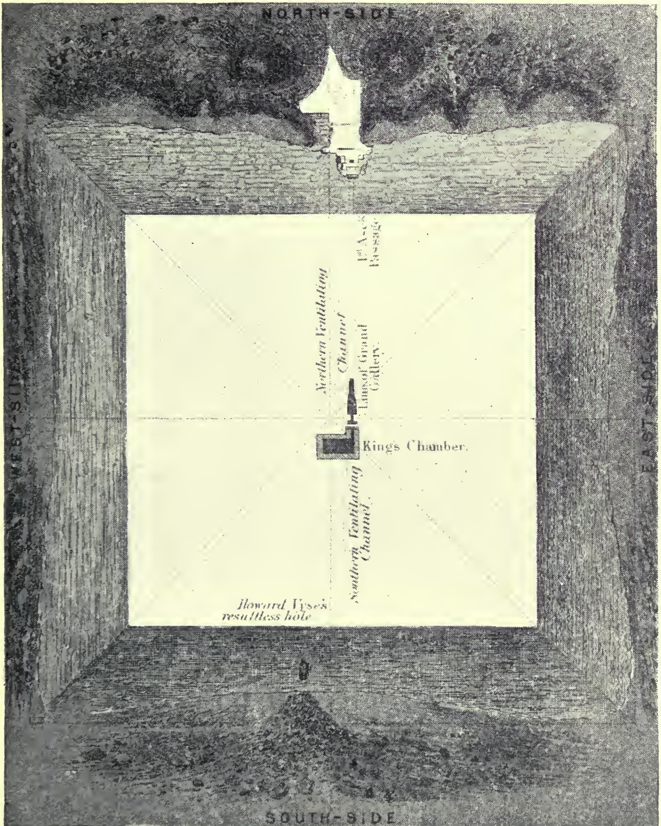


ALL THE PYRAMIDS OF EGYPT, other than those of Jeezeh, beginning from the North and going to the South of the country

SCALE $\frac{1}{5000}$ OF NATURE

SEE PLATE VI. Ground plan of the Great Pyramid, together with the horizontal sectional area at the level of the King's Chamber. Also exhibits the spot on the south side of the pyramid, where Prof. Howard Vyse, made an unsuccessful attempt to force an entrance.

PLATE VI



SCALE $\frac{1}{2500}$ OF NATURE.

GROUND PLAN OF THE GREAT PYRAMID.

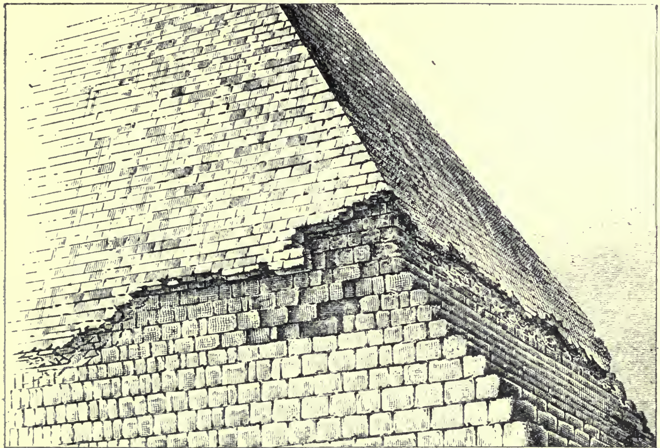
TOGETHER WITH ITS HORIZONTAL SECTIONAL AREA AT THE LEVEL OF THE KING'S CHAMBER.

SCALE OF BRITISH INCHES

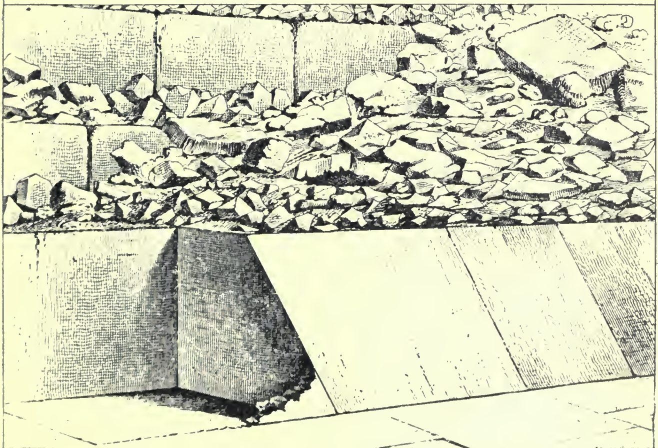
1000 500 0 1000 2000 3000 4000 5000 6000 7000 8000 9000

See Plate VII. The upper part of this illustration exhibits the casing stone remnants of the second pyramid. The lower part of this picture exhibits the first three layers of stone on the north side of the Great Pyramid, including the first layer of the original angle casing stones, as discovered by Col. Howard Vyse, in 1857 A. D.

PLATE VII



EXAMPLE OF THE CASING-STONES OF A PYRAMID, SUPER-POSED.
ON THE RECT-ANGULAR MASONRY COURSES: FROM A PHOTOGRAPH BY P S. OF THE SUMMIT OF THE 2° PYR.

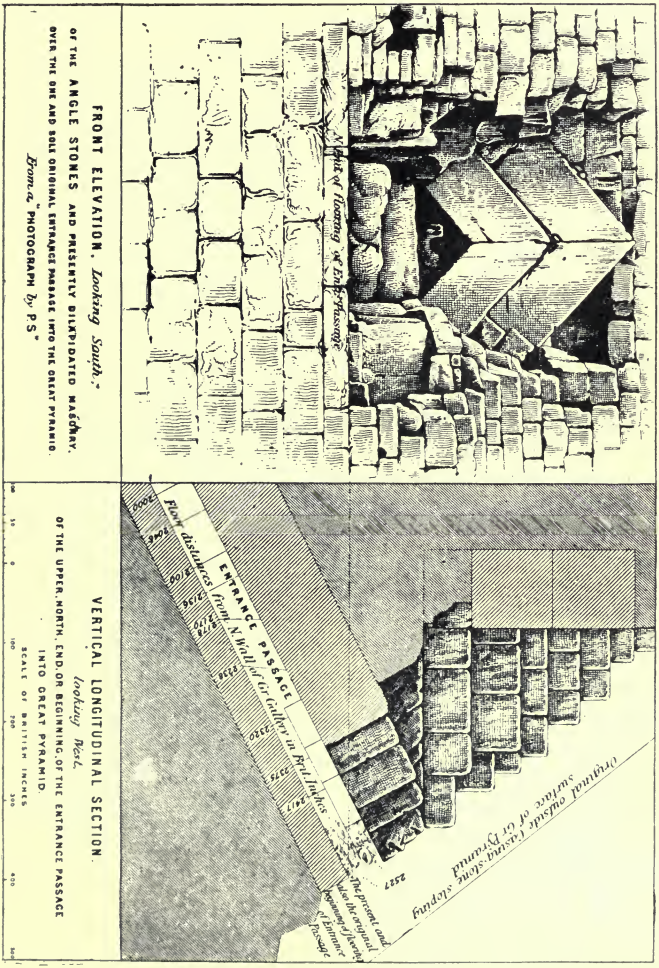


REMNANT OF THE ORIGINAL CASING-STONE SURFACE OF THE GREAT PYRAMID
NEAR THE MIDDLE OF ITS NORTHERN FOOT. AS DISCOVERED BY THE EXCAVATIONS OF COL HOWARD VYSE IN 1837

PIAZZI SMYTH, DEL^T A. RITCHIE & SON EDIN^R

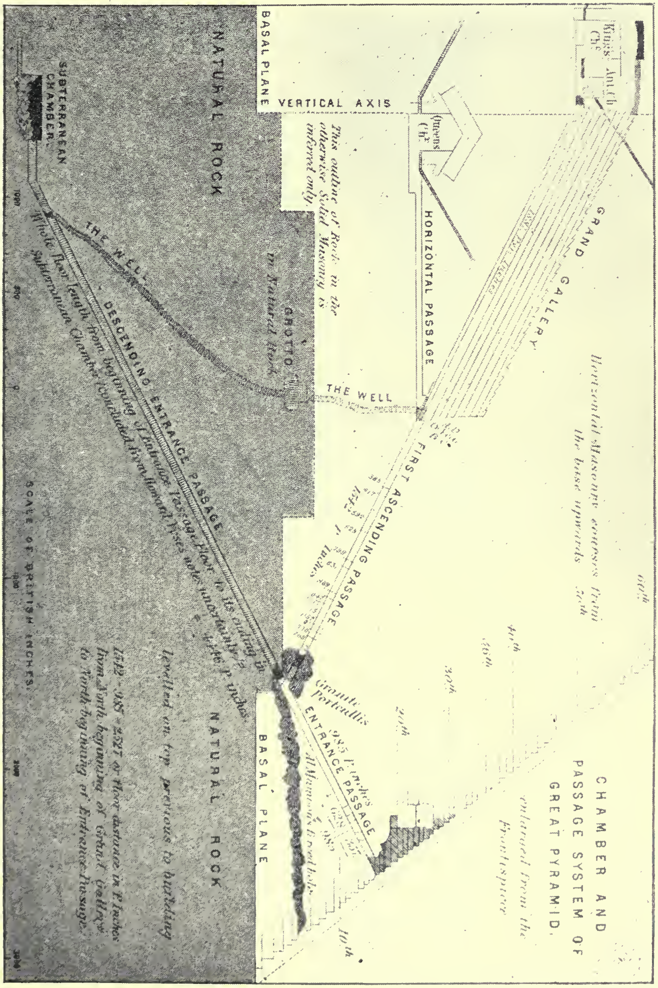
See Plate VIII. Exhibiting a front, also a vertical longitudinal section of the present entrance to the Great Pyramid, and a line drawn showing where the original casing stones reached too, as seen by Caliph Al Mamoun in the year 822 A. D.

PLATE VIII


FRONT ELEVATION. Looking South,
OF THE ANGLE STONES AND PRESENTLY DILAPIDATED MASONRY.
OVER THE ONE AND SOLE ORIGINAL ENTRANCE PASSAGE INTO THE GREAT PYRAMID.
From a "PHOTOGRAPH by P.S"
N. End of flooring of Ent. Passage
VERTICAL LONGITUDINAL SECTION.
looking West.
OF THE UPPER, NORTH, END, OR BEGINNING, OF THE ENTRANCE PASSAGE
INTO GREAT PYRAMID.
SCALE OF BRITISH INCHES
ENTRANCE PASSAGE
Floor distances from N. Wall of Gr. Gallery in Brit. Inches
2000
2048
2100
2136
2178
2179
2238
2320
2375
2417
2527
Original outside Casing-stone sloping surface of Gr. Pyramid
The present and also the original beginning of flooring of Entrance Passage

SEE PLATE IX. Illustrating the chamber and passage system of the Great Pyramid. Also includes the forced hole made by the followers of Caliph Al Mamoun and the unfinished state of the subterranean chamber in the base rock, under the exact center of the Great Pyramid.

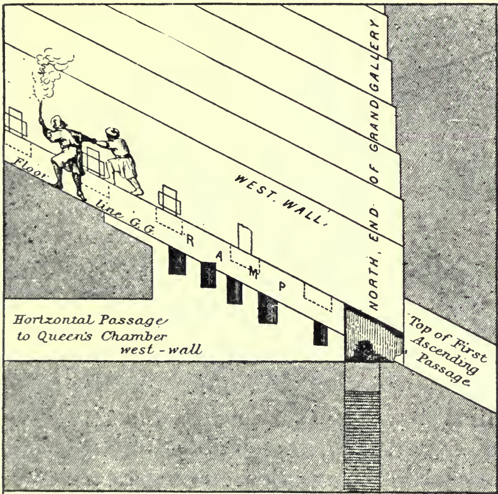
PLATE IX


CHAMBER AND PASSAGE SYSTEM OF GREAT PYRAMID.
NATURAL ROCK
BASAL PLANE
VERTICAL AXIS
SUBTERRANEAN CHAMBER.
THE WELL
DESCENDING ENTRANCE PASSAGE
GROTTO
in Natural Rock
This outline of Rock in the otherwise Solid Masonry is inferred only.
HORIZONTAL PASSAGE
Queens Ch.
Kings Ch.
GRAND GALLERY
FIRST ASCENDING PASSAGE
Granite Portcullis
ENTRANCE PASSAGE
Horizontal Masonry courses from the base upwards
enlarged from the Frontispiece
SCALE OF BRITISH INCHES.

SEE PLATE X. By placing the upper half of this illustration to the right or north side of Plate XIV, a continuous passage is exhibited, and the intention of its original purpose made plain.

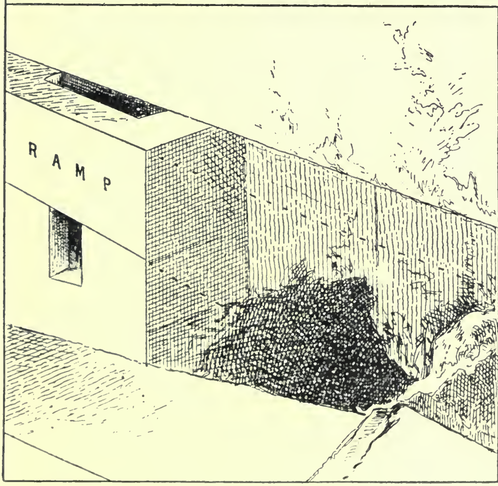
The lower half of this plate exhibits a displaced Ramp stone and entrance to the well. See Plate IX.

PLATE X



SECTION
(vertical and longitudinal)
LOOKING WEST
OF
LOWER OR
NORTHERN END
OF
GRAND GALLERY
IN
GR. PYR^{D}.

SCALE OF BRIT. INCHES 100 50 0



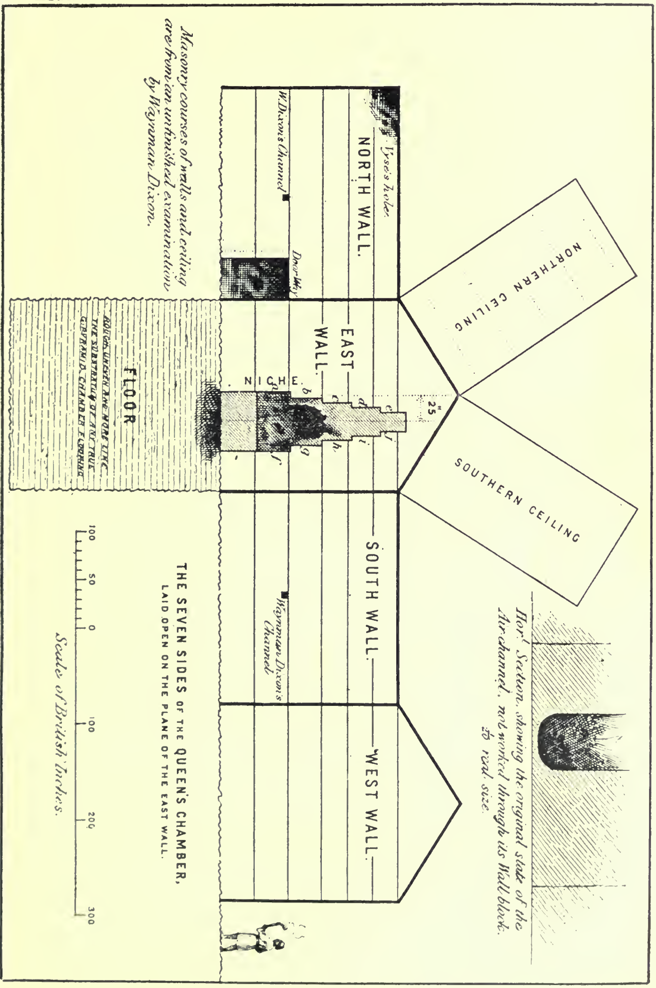
ENLARGED
PERSPECTIVE
VIEW
OF THE
BROKEN OUT
RAMP STONE
AND
THE ENTRANCE
TO THE
WELL.
so called.

PIAZZI SMYTH DEL^{T}. A RITCHIE & SON, EDIN^{R}

SEE PLATE XI. The Queen's Chamber, so-called, in the Great Pyramid. The only chamber exhibiting seven sides. Through the niche in the east wall of which, we expect to find an entrance to other chambers.

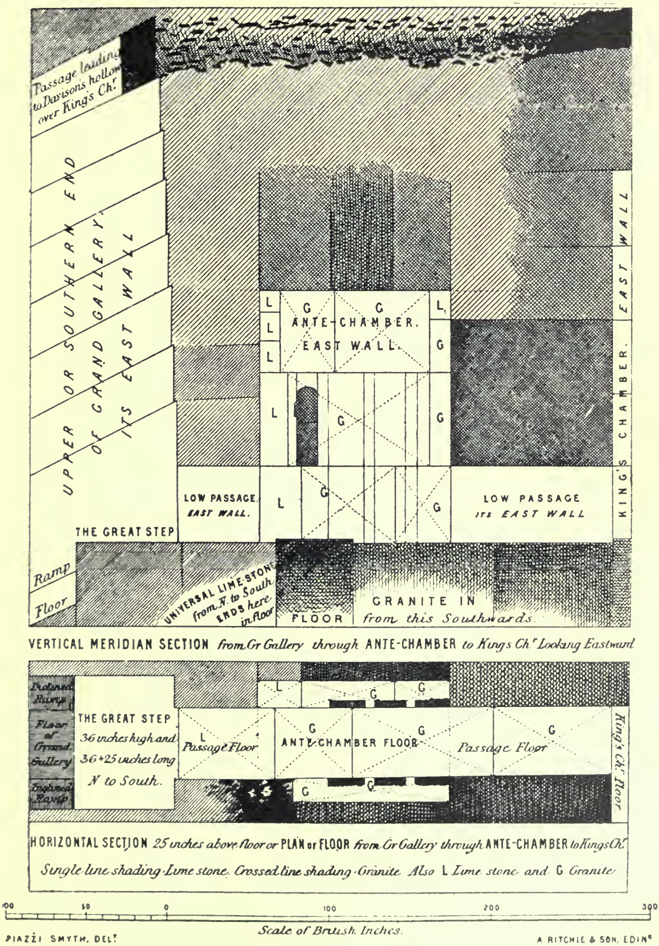
Prof. H. L. Smith, of Hobart College, Geneva, N. Y., (in a private letter) speaking of the Queen's Chamber, in the Great Pyramid, remarks, "Either there is proof in that chamber of supernatural inspiration granted to the architect," or "that primeval official possessed, without inspiration, in an age of absolute scientific ingorance 4,000 years ago, scientific knowledge equal to, if not surpassing, that of the present highly developed state of science in the modern world."

PLATE XI


Masonry courses of walls and ceiling are from an unfinished examination by Waynman Dixon.
NORTH WALL.
Vyse's hole.
W. Dixon's Channel
Doorway
NORTHERN CEILING
EAST WALL.
NICHE.
25"
SOUTHERN CEILING
SOUTH WALL.
Waynman Dixon's Channel
WEST WALL.
FLOOR
ROUGH, UNEVEN AND MORE LIKE THE SUBSTRATUM OF ANY TRUE PYRAMID CHAMBER FLOORING
THE SEVEN SIDES OF THE QUEEN'S CHAMBER,
LAID OPEN ON THE PLANE OF THE EAST WALL.
Hor. Section, showing the original state of the Air channel, not worked through its Wall block.
1/10 real size.
100 50 0 100 200 300
Scale of British Inches.

See Plate XII. Showing the upper end of the Grand Gallery and the ante-chamber. Also exhibiting the great 36 inch step and the low passage way into the King's Chamber; compelling all who enter there to stoop and bow his head, though he might be ruler of the whole world

PLATE XII



VERTICAL MERIDIAN SECTION *from Gr Gallery through* ANTE-CHAMBER *to Kings Chr Looking Eastward*

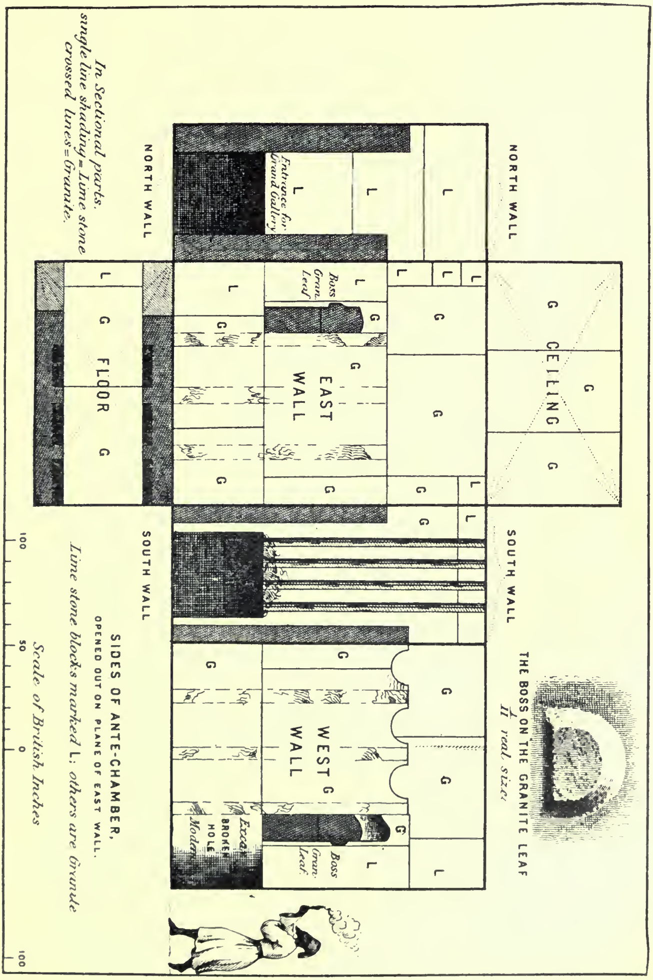
HORIZONTAL SECTION *25 inches above floor or* PLAN or FLOOR *from Gr Gallery through* ANTE-CHAMBER *to Kings Chr*

Single line shading Lime stone. Crossed line shading Granite. Also L *Lime stone and* G *Granite*

PIAZZI SMYTH, DELT. A. RITCHIE & SON, EDINR

SEE PLATE XIII. The Ante-Chamber and its walls opened out; also the Boss on the Granite Leaf. In this chamber all candidates received their preparatory lectures before entering the King's Chamber, and other chambers later on.

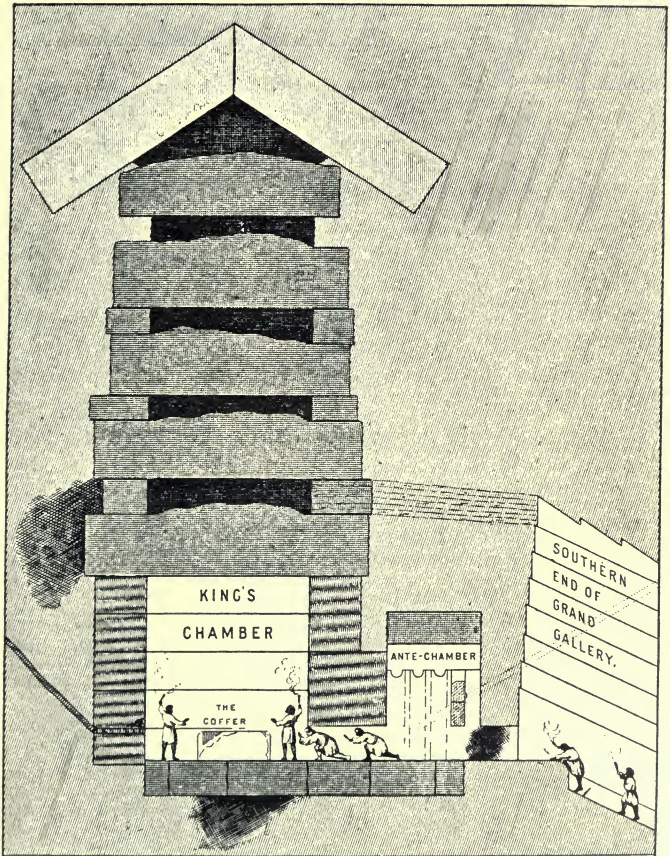
PLATE XIII


NORTH WALL
SOUTH WALL
CEILING
EAST WALL
WEST WALL
FLOOR
Entrance for Grand Gallery
Boss Gran. Leaf
Excav. BROKEN HOLE Modern
THE BOSS ON THE GRANITE LEAF
1/11 real size
In Sectional parts.
single line shading = Lime stone
crossed lines = Granite.
SIDES OF ANTE-CHAMBER,
OPENED OUT ON PLANE OF EAST WALL.
Lime stone blocks marked L: others are Granite
Scale of British Inches
100 50 0 100

SEE PLATE XIV. The King's Chamber and its accessories, which include the ante-chamber, and the southern end of the Grand Gallery. Also Howard Vyse's hollows of construction above the King's Chamber. The crossed lines indicate granite. Some idea of the magnitude of this portion of pyramid construction may be had when we tell you that the first cross tie of granite seen over the King's Chamber is about 4 1-2 feet square, by 25 feet long and it takes 9 of these slabs or ties to form the ceiling to the King's Chamber; each slab of which weighs about 42 tons.

See Plate X. with explanation on page 26. It will be noticed that even a king would have to stoop to enter this chamber.

PLATE XIV



VERTICAL SECTION *(Looking West)* OF KING'S CHAMBER; ALSO OF ANTE-CHAMBER, SOUTH END OF GRAND GALLERY, AND VYSE'S HOLLOWS OF CONSTRUCTION, ABOVE KING'S CHAMBER. CROSSED LINES INDICATE GRANITE.

Scale of British Inches

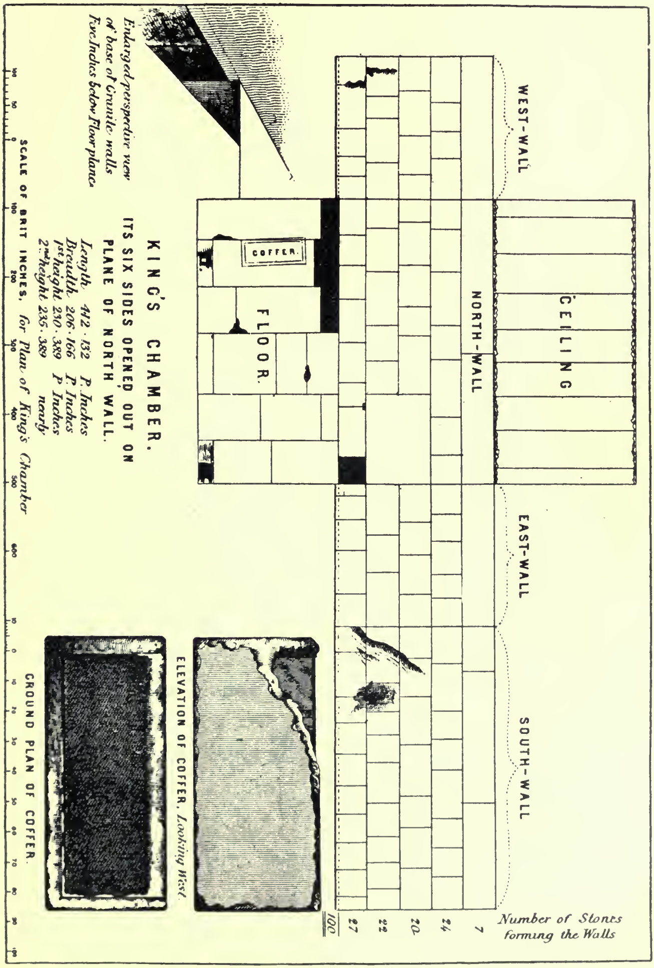
100 50 0 100 200 300 400 500 600 700

PIAZZI SMYTH, DEL^T A RITCHIE & SON EDIN^R

SEE PLATE XV. This illustration indicates the entire plot for which the Great Pyramid was built. Exhibiting the walls of the King's Chamber opened out, also the sunk portion of walls, the coffer, etc.

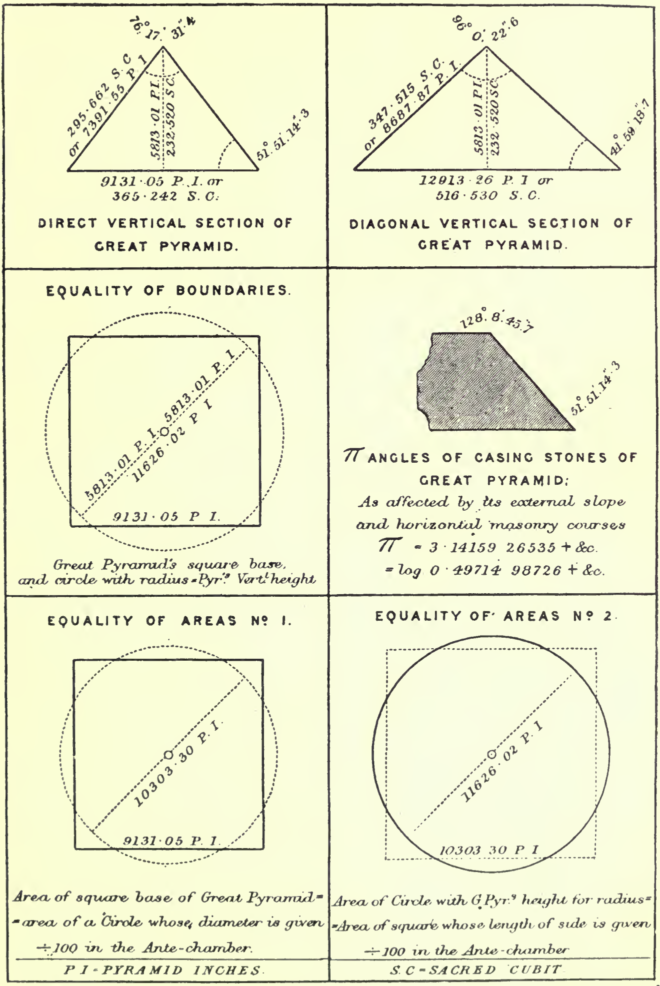
It will be noted that there are just 100 blocks of granite in the four walls of this chamber, nine in the ceiling, and there were eighteen in the floor before they were pried out and taken away. No two of which are of the same size. On the north wall will be noticed one granite block that is twice the size (in height) of any other wall stone, the east edge of which, forms one angle of the N. E. corner of this chamber. This we predict will be found to be a door, and outlet to other chambers, which we have suggested in the body of this work, exist in other parts of this great building. No latches, hinges, locks or bolts exist, but when the secret is re-discovered, it will be opened without force.

PLATE XV


WEST-WALL
CEILING
NORTH-WALL
EAST-WALL
SOUTH-WALL
FLOOR.
COFFER.
Number of Stones forming the Walls
7
24
20
22
27
100
KING'S CHAMBER.
ITS SIX SIDES OPENED OUT ON PLANE OF NORTH WALL.
Length 412·132 P. Inches
Breadth 206·166 P. Inches
1st height 230·389 P Inches
2nd height 235·389 nearly
Enlarged perspective view of base of Granite walls Five Inches below Floor plane
SCALE OF BRIT INCHES, for Plan of Kings Chamber
ELEVATION OF COFFER. Looking West.
GROUND PLAN OF COFFER.

SEE PLATE XVI. Size and shape of Great Pyramid measured without. Showing geometrically direct vertical section; diagonal vertical section; equality of boundaries; angles of casing stones and equality of areas Nos. 1 and 2.

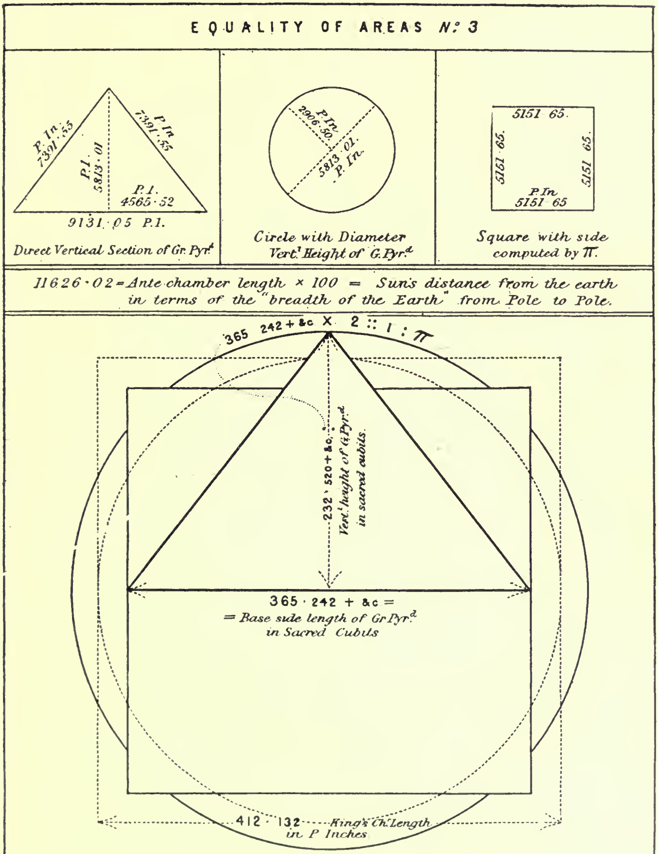
PLATE XVI



PIAZZI SMYTH, DEL.^T A RITCHIE & SON EDIN.^R

SEE PLATE XVII. Size and shape of Great Pyramid from testimony within; equality of areas No. 3. Showing equation of boundaries and areas, circles and squares, inches inside and pyramid cubits outside Great Pyramid.

PLATE XVII



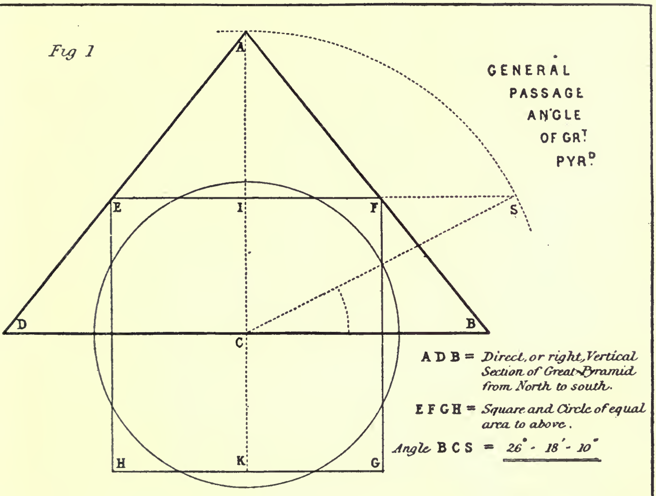
EQUATION OF BOUNDARIES AND AREAS.

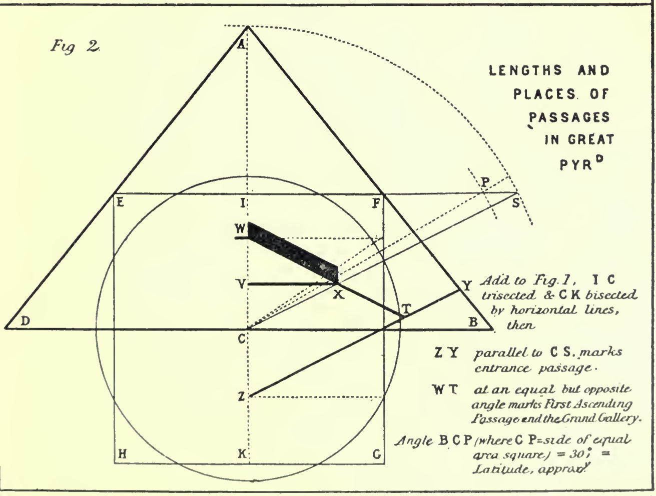
CIRCLES AND SQUARES INCHES INSIDE AND SACRED CUBITS OUTSIDE GREAT PYRAMID.

PIAZZI SMYTH, DELT A. RITCHIE & SON, EDIN

SEE PLATE XVIII. Showing construction hypothesis of passage angles and chamber emplacements in Great Pyramid.

PLATE XVIII

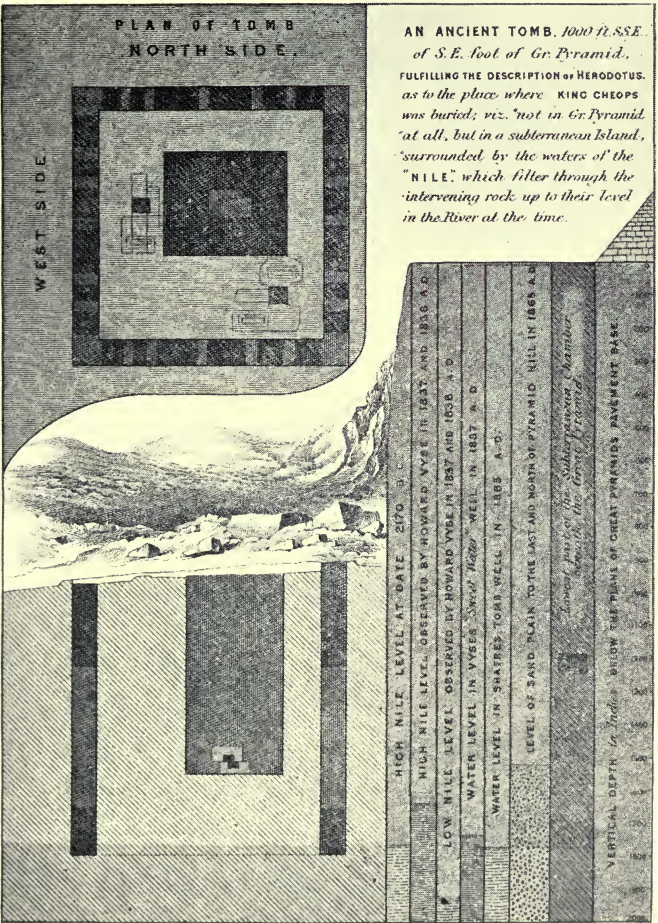




PIAZZI SMYTH DEL^T   A RITCHIE & SON, EDIN^R

SEE PLATE XIX. Tomb of King Cheops, far outside the Great Pyramid. Showing plan and vertical section of the tomb and hydraulic reference data, with regard to the different water levels surrounding the same.

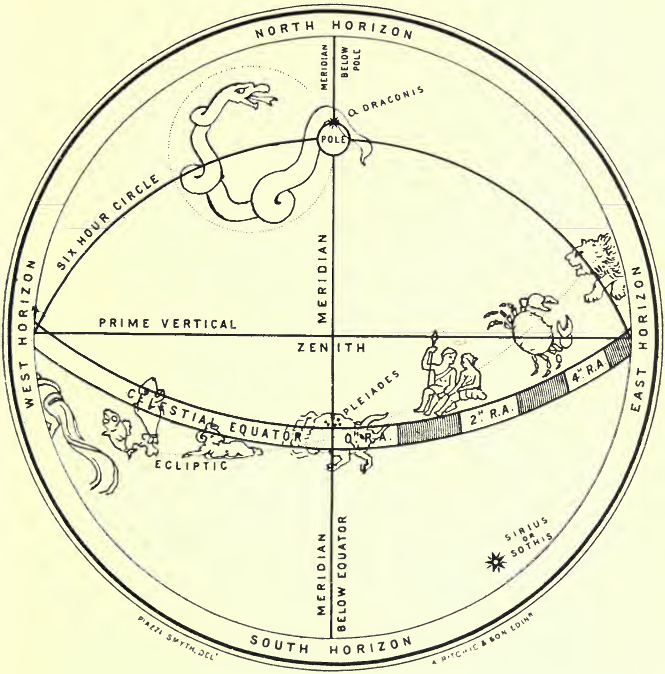
PLATE XIX



VERTICAL SECTION OF TOMB. (LOOKING WEST.) HYDRAULIC REFERENCE DATA FOR SAID TOMB

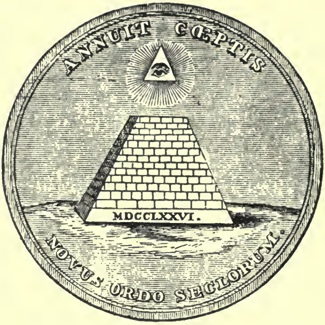
SEE PLATE XX. Showing the starry skies as seen at the Great Pyramid at the date of its foundation, and other anniversaries of that ancient period: *viz.*, 53,770 B. C.; 27,970 B. C.; and 2,170 B. C. This position of the stars occur but once in every 25,800 years.

PLATE XX



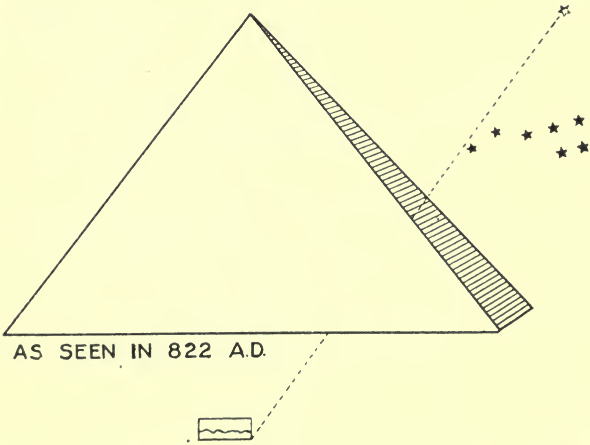
GROUND PLAN OF THE
CIRCLES OF THE HEAVENS ABOVE THE GREAT PYRAMID, AT ITS EPOCH
OF FOUNDATION AT MIDNIGHT OF AUTUMNAL EQUINOX
2170 B.C.
α DRACONIS ON MERIDIAN BELOW POLE AT ENTRANCE PASSAGE ANGLE;
AND PLEIADES ON MERIDIAN ABOVE POLE IN 0^h R.A.,
OR COINCIDENTLY WITH VERNAL EQUINOX.

PLATE XXI



The above illustration shows the Reverse side of the "Great Seal" of the U. S.; it shows a pyramid unfinished. In the zenith an eye in a triangle, surrounded with a glory, proper; over the eye these words, "Annuit Coeptis," meaning God has favored the undertaking. On the base of the pyramid the numerical letters M D C C L X X V I., (1776) and underneath the following motto: "Novus Ordo Seclorum," meaning the beginning of a new series of ages.

The pyramid signifies strength and duration; the eye over it and the motto alludes to the many and signal interpositions of Providence in favor of the American cause. The date underneath is that of the Declaration of Independence; and the words under it signify the beginning of the new era. (This side of the Great Seal is not used.)



AS SEEN IN 822 A.D.

By Caleph Al Mamoun and his followers, when forcing an entrance into the northern base of the Great Pyramid. See article in part first regarding the same.

EGYPT

NOTE.—Egypt was called Mizraim down to 1485 B. C.

The first seat of political civilization is now conceded by most historians to have been in Egypt; the only difference being the date that it occurred, or the time that has elapsed since the political organization of men.

A few of the authorities for the above statement are: "Champolion," discoverer of the "Key" to the "Hieroglyphics" on the "Rosetta Stone," which, with the aid of other history, indicate to him that "Isis," the first prominent ruler of men (see Ancient Masonry, this work), flourished 250,000 years B. C. The first ruler over all Egypt, by other authorities, was "Menes," the founder of the first thirty dynasties; the dates and authorities for the founder of "Memphis" (Menes) are: Bunsen, 3,643 B. C.; Lepsius, 3,892; Poole, 2,717; and others varying some 1,000 years more. The first epoch (for which we have written history) is the dynasty of the Pharaohs, commencing with Mizraim, son of Ham, second son of Noah, 2,188 B. C., to the conquest of Cambyses, 525 B. C.; second epoch, to the death of "Alexander the Great," and establishment of the Ptolemies, 323 B. C.; third epoch to the death of "Cleopatra," and the subjugation by the Romans, 30 B. C.

RULERS.	GENEALOGY, HISTORY, ETC.	REIGN.	
		TIME.	YRS.
Isis (conjectured)	Builder of "Memphis," 250,000 B. C. Building of the original "Cheops," conjectured, 150,000 to 25,000 B. C.	B. C.	
Menes	First dynasty, conjectured, 3643 or	2717—	
Mizraim	Builds Memphis, (Blair)	2188—	
	Egypt divided into four kingdoms, viz: "Egypt proper, Upper Egypt, Lower Egypt, and Memphis"	—2126	62
Busiris	Builds "Thebes," (Usher)	2126—2111	15
Osymandyas	First warlike king; conquers Bactria, Asia. (Usher, Lenglet)	2111—2080	31
(Shepherd Kings)	Phoenicians invade "Lower Egypt," and hold it from	2080—1821	259
Amenophis I	Acknowledged king of all Egypt	1821—	
Rameses III., or Sesostris	King; conquers many countries, builds walls and pyramids	1618— —1492	126
Amenophis II	Drowned in "Red Sea" with army	1492—1491	1
Egyptus	Egypt, changes name from Mizraim	1491—1485	6
Thuoris	Reigns, "the Proteus of the Greeks."	1189—	
Pscusennes (Shishak)	Enters Palestine, ravishes Judea	971—825	146
Petubastes	Of the Tanite Kings	825—781	44
Saites	Dynasty of. (Blair)	781—760	21
Bocchoris	Roasted alive by "Sebacon"	760—737	23
Sebacon	Ethiopian, subdues Bocchoris	737—650	87
The Dodekarchy (12 rulers)	Expelled by "Psammetichus"	650—647	3
Psammetichus	He invests Azoth; it holds out 19 y'rs	647—610	37
Necho	Begins a canal, between the Arabian Gulf and Mediterranean Sea	610—601	9
Apries	Deposed by Nebuchadnezzar	601—591	10
Nebuchadnezzar	Of Babylon. The line of the Pharaoh's ends	591—526	65
Cambyses	An excessive, cruel tyrant	526—487	39
Xerxes	Also king of Persia	487—465	22
Inarus	Incited a revolt. (Blair)	465—463	2
Amyrtaeus	Proclaimed King. (Lenglet)	414—350	64
Orchus	Also King of Persia	350—332	18
Alexander the Great	Conquers Egypt, founds Alexandria	332—323	9
Ptolemy I., Lagus	Soter, re-establishes the monarchy	323—285	38
Ptolemy II, Philadelphus	(With his father)	285—247	38
Ptolemy III., Euergetes	King, reigns	247—222	25
Ptolemy IV., Philopator	Defeats Antiochus, King of Syria	222—205	17
Ptolemy V., Epiphanes	Sends an Embassy to Rome	205—181	24
Ptolemy VI., Philometor	His Queen marries his brother	181—146	35
Ptolemy VII., Euergetes	Murders his brother's child; driven from his throne for his many cruelties in 130; regains throne, 128.	146—117	29
Ptolemy VIII., Soter II., and Cleopatra	Son and mother, rule	117—107	10
Alexander I	Ptolemy VIII. deposed	107—89	18
Ptolemy VIII	Son of Cleopatra, restored	89—81	8

EGYPT--Continued.

Rulers	Genealogy, History, etc.	Reign Time	Reign Yrs.
Alexander II. and Cleopatra I	Rule jointly	81—80	1
Ptolemy IX., Auletes	Deposed	80—58	22
Berenice and Tryhoena	Rule 3 years and fly the throne	58—55	3
Ptolemy IX., Auletes	Restored	55—51	4
Ptolemy and Cleopatra II	Brother and sister	51—43	8
Cleopatra II	Poisons her brother, rules alone. She and Mark Antony kill themselves	43—30	13
Octavius, Caesar	Enters Egypt, the Empire becomes a Roman province	30 B. C.	
	"See Rulers of Rome"	A. D. 616	646
Chosroes II	Of Persia, conquers Egypt	616—638	22
Amrou	Of the Saracens, invades Egypt "See Saracens, rulers of Rome."	638—163	525
(Conquest of the Turks)	Turkish rulers	1163—1196	33
(Mamelukes rule)	Their government established, 1250	1196—1517	321
Selim I	Emperor of the Turks	1517—1520	3
(Turkish rulers)	conquer Egypt. "See Turkey."	1520—1790	270
Bonaparte	Napoleon I. of the French holds the country for 11 years	1790—1801	11
(Turkish rulers)	The British restore Egypt to Turkey in 1801	1801—1806	5
Mehemet Ali Pacha	Khedive, hereditary Viceroy	1806—1848	42
Ibrahim	(Adopted.) Son of Mehemet	1848—1848	2m
Abbas	Son of Ibrahim, Khedive	1848—1854	6
Said	Brother of Abbas. Khedive	1854—1863	9
Ismail	Nephew of Said, Khedive	1863—1879	16
Mohammed Tewfik	Son of Ismail, Khedive	1879—1892	13
Abbas II, Hilmi	Son of Said	1892—	

(Sec. 1.) EGYPT (in Greek, Aiguptos; in Hebrew Misr or Misraim; in the language of the country in hieroglyphics, Kemi—which signifies the black land; and by the Arabs of the present day called Misr), a country in the northeastern part of Africa. Egypt was conquered by the Turks in 1517. The Viceroyalty was made hereditary in 1841. The Sultan granted to the Khedive the rights of concluding treaties with foreign powers and of maintaining armies June 8, 1873. The annual tribute paid to Turkey is about $3,000,000. Egypt proper extends from the Mediterranean Sea south to lat. 22° N., and from the latter region, known as the Egyptian Soudan, is governed by Egypt and Great Britain jointly. The eastern boundary is the Red Sea, and on the extreme northeast Syria. The western boundary runs northwest to Tripoli, and thence southeast to a point 200 miles west of Wady-Halfa. One-third of the Libyan Desert also belongs to Egypt. The area of Egypt is about 383,800 square miles. It extends about 675 miles north and south, and 500 miles east and west. Its population is about 10,500,000.

TOPOGRAPHY.—In ancient as in modern times, Egypt was always divided into the Upper and the Lower, or the Southern and the Northern country; and at a very early period it was further subdivided into a number of nomes, or departments, varying in different ages; 42 was probably the usual number. A third great division, the Heptanomis, or seven nomes, preserved in modern "Middle Egypt" (Wustani), was introduced at the time of the geographer Ptolemy. Each nome or department had a separate local government. In the 5th century A. D., Egypt was divided into Augusta Prima and Secunda on the east, and Ægyptiaca on the west, Arcadia (the Heptanomis), Thebais Proxima as far as Panapolis, and Thebais Supra to Philæ. Under the Mohammedans, the triple division into Misr el-Bahri (Lower Egypt), el-Wustani (Middle) and es-Said (Upper) has prevailed, but the number of subdivisions has varied; at present there are altogether thirteen provinces. Egypt is connected with Asia by the Isthmus of Suez, across which runs the great ship canal without locks now connecting the Mediterranean with the Red Sea; running from Port Said on the former to Suez on the latter, a distance of 99 miles. According to Herodotus a large canal from the Red Sea to the Nile was constructed about 600 B. C. This canal, which seems never to have been of much use, was finally blocked up about 767 A. D. Napoleon I. had conceived the idea of making a ship canal across the Isthmus of Suez. In 1854, the French engineer, M. Ferdinand de Lesseps, obtained a concession for that purpose, and in 1858 was able to form a company for carrying on the work. Operations were begun on April 25, 1859, and on Nov. 17, 1869, the canal was opened; the total cost of construction was $102,750,000. There were 75 miles of actual excavation, the remaining 24 miles being through shallow lakes (Lakes Menzaleb, Lake Timsah, and Bitter Lakes), which usually had to be deepened. For about four-fifths of its length it was originally 327 ft. wide at the surface of the water, 72 feet at the bottom, and 26 feet deep; for the remainder only 196 ft. wide at the top, the other dimensions being the same; but the increase of traffic led to its being widened and deepened several years ago. By an agreement signed Oct. 29, 1888, the canal was exempted from blockade, and vessels of all nations, whether armed or not, are to be allowed to pass through it in peace or war. During the year 1906, some 4000 ships passed through this canal, for which privilege the company received over $20,000,000. A canal was also constructed for bringing fresh water from the Nile at a point near Cairo. This canal reaches the salt water canal at Ismailia, and then runs almost parallel to the ship canal to Suez. It is almost 40 ft. wide and 9 deep, and is used for navigation as well as for domestic purposes and irrigation. The land on both sides of the ship canal is to be retained by the company for ninety-nine years. Navigation at night by the aid of electric light began on March 1, 1887, and has shortened the time of passage by about one-half, viz., to about sixteen to twenty hours. Steamships are allowed to sail at a speed of five to six knots an hour along the canal. The inhabited portion of Egypt is mainly confined to the valley and delta of the Nile, which where widest does not exceed 120 miles, while in many parts of the valley it is only from 10 to 15 miles wide, and at the southern frontier of Egypt only two miles. West of the Nile are several oases. Two ranges of lofty mountains, the Arabian Hills on the east and the Libyan on the west, enclose this valley. The delta of the Nile is traversed by a network of primary and secondary channels, and is also intersected by numerous canals. Seven principal channels, or mouths, were usually recognized in ancient times, the names of which, going from east to west, were the Pelusiac mouth, the Tanitic, the Mendesian, the Phatnitic (Damietta), the Sebennytic, the Bolbitic (Rosetta), and the Canoptic. The Nile has a current running seaward at the rate of 2 1-2 or 3 miles an hour, and the stream is always deep enough for navigation. The water becomes a reddish brown during the annual overflow; it is esteemed highly salubrious. Near the sea are Lakes Menzaleh, Mariut (Mareotis), and other extensive but shallow lagoons. The openings or lateral valleys of the hills confining the valley of the Nile are comparatively few, or, being little frequented, are not well known. Those on the east side are the Valley of the Wanderings (of the children of Israel), leading from the neighborhood of Cairo to the head of the Gulf of the Suez, and that through which passes the road from Koptos to Kosseir on the Red Sea. A short distance west of the Nile and above the delta is the fertile valley of Fayoum, in the northwest and lowest part of which is the Birket-Kerun Lake or Birket-el-Kerun, fed by a canal or branch from the Nile. The level of the lake is now 130 feet below that of the Mediterranean. This lake, formerly known as Lake Moeris, anciently covered a far larger area.

and by means of sluices and other works was utilized for irrigation purposes. The deserts on the west bank of the Nile generally present to view plains of gravel or of fine drifting sand; on the east the scene is varied by rocks and mountains.

CLIMATE.—The atmosphere in Egypt is extremely clear and dry, the temperature regular and hot, though the heat is tempered during the daytime for seven or eight months of the year by the strong wind which blows from the north, and which enables sailing vessels to ascend the river against the stream. The winter months are the most delightful of the year, the air being cool and balmy, and the ground covered with verdure; later, the ground becomes parched and dry, and in spring the suffocating khamseen, or simoon, frequently blows into the Nile valley from the desert plains on each side of it, raising clouds of fine sand, and causing great annoyance, until the rising of the river again comes to bless the land. It rains but rarely, except near the seashore. At Memphis, the rain falls perhaps three or four times in the course of a year, and in Upper Egypt only once or twice, if at all; showers of hail sometimes reach the borders of Egypt, but the formation of ice is very uncommon. Earthquakes are rare occurrences and so slight as to be seldom recorded (see article on earthquakes in another portion of this work), and thunder and lightning are neither frequent nor violent. Egypt is not remarkably healthy, especially in the delta—ophthalmia, diarrhœa, dysentery, and boils being somewhat prevalent. But many invalids now winter in Egypt, especially in the neighborhood of Cairo, or higher up the river, where the air is dry and pure.

THE NILE AND IRRIGATION.—The great historic river Nile, anciently called the Nilus, is 4,100 miles in length, and one of the few great rivers and second longest in the world. It is only exceeded by the Missouri and Mississippi (from its junction) which combined are 4,575 miles long. It divides, at lat. 30° 15′, just below the first cataract, into two main streams, one entering the sea by the Rosetta mouth on the west, the other by the Damietta mouth on the east. These two streams carry the bulk of the Nile water to the Mediterranean, and enclose a large portion of the territory known as the delta, from its resemblance to the Greek letter Δ, and which owes its existence to the deposits of alluvial matter brought down by the stream. A most remarkable phenomenon connected with the Nile is its annual regular increase, rising from its periodical rains, which fall within the equatorial regions and the Abyssianian mountains. As rain rarely falls in Egypt, the prosperity of the country entirely depends on this overflowing of the river. On the subsiding of the water the land is found to be covered with a brown slimy deposit, which so enriches the soil that with a sufficiency of water it produces two crops a year, while beyond the limits of the inundation and irrigation there is no cultivation whatever. The Nile begins to rise in June, and continues to increase until about the end of September, overflowing the lowlands along its course, the water being conveyed to the fields by artificial courses where natural channels fail. After remaining stationary for a short time, the river rises again still further, and subsequently begins to subside, showing a markedly lower level in January, February and March, and reaching its lowest in April, May, and early June. The overflow of the water is now to a great extent managed artificially by means of an extensive system of reservoirs and canals, so that after the river subsides it may be used as required. A certain proportion of the fields, after receiving the overflow and being sown, can ripen the crop without future moisture; but many others always require artificial irrigation. Steam pumps are now largely used in Northern Egypt. Latterly the government has tried to make the farmer less and less directly dependent on the inundation, and the great barrage of the Nile below Cairo, the largest weir in the world, is one means to this end, a great barrage or dam at Assouan being another.

The native methods of raising water for irrigation are chiefly by the sakieh, or water wheel, and the shadoof. The first consists of a horizontal wheel turned by one or two oxen, which sets in motion a vertical wheel, around which are hung a number of earthen jars, this wheel being sunk into a reservoir connected with the river. The jars thus scoop up the water and bring it to a trough on a level with the top. Into this trough each jar empties itself in succession, and the water is conducted by an inclined channel into the cultivated ground adjoining, which may have been previously divided into compartments of 1 or 2 yards square by raising the mold into walls or ridges of 5 or 6 inches in height. Into these compartments the cultivator forms an entrance for the water, by depressing a little space in the ridge or wall with the sole of his foot; and this overlooking of the channels of irrigation, and the adjustment of the openings from one compartment to another with the foot, is continued until the cultivator is assured by the growth of the plants that each compartment is daily and duly supplied with its proper quantity of water. The second means of raising water, namely, the shadoof, consists of a leathern bucket slung at one end of a pole which has a weight at the other and sways up and down on a vertical support, a contrivance by which the cultivator is enabled to scoop up the water considerably below his feet and raise it with comparative ease to the mouth of a channel on a level with his breast. The latter mode of raising water is of great antiquity, and is depicted on the walls of the ancient tombs of Egypt, and also in the sculptures of Nineveh. A sufficient rise of the river (the rise varies at different points) is essential to secure the prosperity of the country; and as the water subsides the chaplet of buckets on the sakieh is lengthened, or several shadoofs, rising one above the other on the river banks, are required. Should the Nile rise above the requisite height it may do great damage; while if it should not attain the ordinary height there is a deficiency of crops; but so regular are the operations of nature that, with rare exceptions, the inundations are nearly uniform.

OASES.—The fertile spots peculiar to the deserts of Africa are found in Egypt along the hollow region of the Libyan Desert, parallel to the general direction of the valley of the Nile, and about 80 miles west of it. The Great Oasis, or El Wah (the oasis) el Khargeh, lies immediately west of the Thebaid, and has a length of 100 miles. About 50 miles west of the northern extremity of this oasis, lies the Wah el Dakhileh, 24 miles long and 10 miles broad. West by south from the Fayoum, the date groves of the Little Oasis, or Wah el Baharieh, display their usual verdure. In this fertile spot artesian wells are numerous, and some of ancient construction have been discovered which have depths exceeding 400 feet. On the road between this oasis and that of El Dakhileh, inclining to the west, occurs half-way the Wah el Farafrah, of small extent. West of the Fayoum, and about 200 miles from the Nile, lies the oasis of Siwah. The inhabitants of this secluded spot, though tributary to Egypt, are in language and manners wholly Libyan. The region of the oases terminates toward the north in the desert of the Natron lakes.

ZOOLOGY.—Owing to the absence of forests in Egypt there are few wild animals, the principal species being the wolf, fox, jackal, hyena, the wild ass, and several kinds of antelope. The chief domestic animals are camels, horses, asses, horned cattle, and sheep. The hippopotamus is no longer found in Egypt, though it is met with in the Nile above the cataracts, and the crocodile has abandoned the lower part of the river, and is becoming rare even in Upper Egypt. Among the birds are three species of vultures (one of which is very large, individuals sometimes measuring 15 feet across the wings), eagles, falcons, hawks, buzzards, kites, crows, linnets, larks, sparrows and the beautiful hoopoe, which is regarded with superstitious reverence. Pigeons and various kinds of poultry are very abundant. The ostrich is found in the deserts. Among the reptiles are the cerastes and naja haje, both deadly poisonous. Fishes abound in the Nile and in the lakes, and furnish a common and favorite article of food. Water-fowl are plentiful and were anciently prepared and salted like fish. The sacred ibis is still a regular visitor during the inundation, and the pelican is found in the northern lagoons. Among the countless insects are the sacred beetle, the locust and mosquito. Many of the animals, birds and reptiles were held sacred by the people; whoever killed a sacred animal, an ibis or a hawk, was put to death. If a cat died a natural death every person in the house shaved his eyebrows; if a dog died, the whole body and head was shaved. The cats were buried at Bubastis, the dogs in the vaults of their own cities, field mice and hawks at Buto, the ibis at Hermopolis, and other animals where they were found lying. Of all animals, the sacred calf Apis was the most revered. His chief temple was at Memphis. The females, being sacred to Isis, were thrown into the Nile, which was considered sacred, and the males were buried at Sakkara.

BOTANY.—The few trees found in Egypt include the date palm, tamarisk, sycamore, Christ's-Thorn, carob, and two species of acacia. Many trees have been planted in recent times, especially about Cairo, such as the lebbek (Albizzia Lebbek) and the eucalyptus. The papyrus plant, once so important, is now to be found only in one or two spots. Of it was manufactured a paper, which was supplied to all the ancient world. Boats, baskets, cords and shoes were also made of it. Wine was abundantly produced in ancient Egypt, and the sculptures bear ample testimony to the extent to which the ancient Egyptians indulged in wine and beer or other intoxicating beverages. The vine is still cultivated, but little or no wine is made, as it can easily be imported. The following plants are sown immediately after the inundation begins to subside, and are harvested three or four months later: wheat, barley, beans, peas, lentils, vetches, lupins, clover, flax, lettuce, hemp, coriander, poppies, tobacco, watermelons and cucumbers. The following plants are raised in summer chiefly by artificial irrigation: durra, maize, onions, henna, sugarcane, cotton, coffee, indigo, and madder. Grapes are plentiful, and other fruits abound, of which the most common are dates, figs, pomegranates, apricots, peaches, oranges, lemons, citrons, bananas, mulberries, and olives. The lotus or water-lily is the chief species of flora found in Egypt. There is a high coarse grass called halfa and various kinds of reeds and canes.

GEOLOGY AND MINEROLOGY.—Granite, limestone and sandstone are the principal rock formations found in Egypt. In the Nile Valley sandstone prevails, from the quarries of which most of the temples of Egypt have been built. At Syene, at the southern extremity of the country, granite predominates, and the quarries there have furnished chiefly the materials for the obelisks and colossal statues of Egypt. Over a great extent of the country the rocks are covered with moving sands, and in the lands bordering on the Nile by the alluvium deposited during the inundations which consists of an argillaceous earth or loam, more or less mixed with sand. This sedimentary deposit has no traces of stratification. Various other minerals in addition to those already mentioned, and which were used in the ancient buildings, sculpture, vases, etc., include syenite, basalt, alabaster, breccia and porphyry. Among other valuable products were emeralds, gold from the mines in Upper Egypt, iron from the desert plains of Nubia, and natron from the lakes in the Oasis of Ammon, hence called sal ammoniac. Bitumen, salt and sulphur are also among the minerals of Egypt.

INHABITANTS.—Of the inhabitants of Egypt those of the peasant class, or Fellahs, as they are called, are undoubtedly indigenous, and may be regarded as descendants of the ancient Egyptians. They have mostly embraced Mohammedanism. The Copts are the descendants of the ancient Egyptians who embrace and still cling to the Christian religion. Though comparatively few in number (about 600,000), their education and useful talents enable them to hold a respectable position in society. The Fellahs are generally peasants and laborers; the Copts fill the posts of clerks, accountants, etc. With these aboriginal inhabitants are mingled, in various proportions, Turks, Arabs (partly Bedouins), Armenians, Bérbers, negroes and a considerable number of Europeans. The Turks hold many of the principal offices under the government. The great bulk of the people are Mohammedans, the Christians being only about 7.5 per cent. The Egyptians in the mass are quite illiterate, but under the supervision of the ministry of public instruction progress is being made. In 1902 there were about 10,000 schools with 228,000 pupils. The language in general use is Arabic.

The Fellahs, the most superior type of the Egyptian, are a fine race, handsome, of excellent physique, and courteous in their manners. In northern Egypt they are of a yellowish complexion, growing darker toward the south, until the hue becomes a deep bronze. Mr. Lane, the best authority upon the subject, speaks highly of their mental capacity and gives them credit for uncommon quickness of apprehension and readiness of wit. They are highly religious, and are generally honest, cheerful, humane, and hospitable. But these are exceptions in a mixed population of Bedouins, negroes, Abyssinians, Jews and Europeans. The dominant population appears, from the language, and from the physical confirmation of the mummies, to have been of mixed origin, part Asiatic and part Nigritic; and there seems to have been an aboriginal race of copper color, with rather thin legs, large feet, high cheek bones, and large lips; both types are represented on the monuments. The statements of Greek writers that a system of castes prevailed in Egypt are erroneous. What they took for castes were really conditions of society, and the different classes not only intermarried, but even, as in the case of priests and soldiers, held both employments.

As in all bureaucracies, the sons often obtained the same employments as their fathers. The population must have been very large at the earliest period. It has been placed at 7,000,000 under the Pharaohs, distributed in 1,800 towns, which had increased to 2,000 under Amasis (525 B. C.), and upwards of 3,000 under the Ptolemies. In the reign of Nero it amounted to 7,800,000. The population in 1844 was 2,500,000; in 1859, 5,125,000; in 1882, 6,817,265, and in 1897, 9,734,405. The population in 1906 is estimated at 10,500,000, which includes 41,000 Greeks, 25,000 Italians, 20,000 British and 18,500 French. The chief towns of Egypt proper are Cairo, (population 625,000); Alexandria (350,000); Damietta (47,000); Tantah (57,500); Assiut (42,000); Mansurah (34,000); Fayum (31,500); Damanhur (32,000); Zagazig (20,000); Rosetta (17,500); Port Said (18,500); Suez (12,500).

GOVERNMENT.—The ancient government of Egypt was a monarchy, limited by strict laws and by the influence of powerful hereditary privileged classes of priests and soldiers. The priests were the ruling class. They were restricted to a single wife, and if polygamy was permitted to the rest of the people, it must have been very seldom practiced. The marriage of brothers and sisters was permitted. The laws generally were wise and equitable, and appear to have been rigidly enforced. Murder was punished with death, adultery by bastinadoing the man and by cutting off the nose of the woman, forgery by cutting off the culprit's hands. Imprisonment for debt was not permitted, but a man could pledge to his creditors the mummies of his ancestors, and if he failed in his life-time to redeem them, he was himself deprived of burial. Women were treated with respect, and the laws and customs seem to have been so favorable to them that their conditions in Egypt were much higher than in any other nation of antiquity. The military force of Egypt was a species of hereditary militia, which formed one of the leading classes or castes, and in time of peace cultivated the land of which it held a large portion. The king's guards, some few thousands in number, formed the only standing army. The number of soldiers in the military caste is stated by Herodotus at 410,000, which probably included all the men of that class able to bear arms. It is not probable that the whole of them ever were or could have been brought into the field at once. Their arms were spears and swords, and they were protected by large shields.

At the present day the government is in the hands of the viceroy or khedive, as supreme ruler, who pays an annual tribute of about $3,000,000 to Turkey and is assisted by a ministry formed on the model of those of western Europe. The capital is Cairo. The government is carried on under the supervision of Great Britain, the rebellion of Arabi Pasha in 1882 having been put down and the authority of the khedive restored by British troops. For some years previous to this, two controllers-general, appointed respectively by France and Britain, had extensive powers of control in the administration of the country. The British have initiated various reforms in the administration, such as the establishment of new native tribunals. The administration of justice is somewhat complicated, there being native tribunals, consular courts, mixed tribunals, and religious courts. The financial condition of Egypt is being slowly improved under British management. The Egyptian army is under the command of an English general, and officered partly by Englishmen and partly by Egyptians; its total strength is 18,100, while the English army of occupation, which, since the rebellion of 1882, has remained in Egypt, has a strength of 5,600.

HISTORY.—The history of Egypt, prior to the beginning of the ancient empire 4000 B. C., is entirely mythical. The history divides itself into six great periods: (1) The Pharaohs or native kings; (2) the Persians; (3) the Ptolemies; (4) the Romans; (5) the Arabs; (6) the Turks.

The main sources of its history under the Pharaohs are the Scriptures, the Greek writers Herodotus, Diodorus, and Eratosthenes, some fragments of the writing of Manetho, an Egyptian priest in the 3rd century B. C. From the Scriptures we learn that the Hebrew patriarch, Abraham, went into Egypt with his family because of a famine that prevailed in Canaan. He found the country ruled by a Pharaoh, the Egyptian term for king. The date of Abraham's visit, according to the chronology of the Hebrew text of the Bible, was 1920 B. C.; according to the Septuagint, 2551; while Bunsen fixes it at 2876. Nearly two centuries later, Joseph, a descendant of Abraham, was sold into Egypt as a slave to the captain of the guards of another Pharaoh, whose prime minister or grand vizier the young Hebrew eventually became. Joseph's father, Jacob, and his family, to the number of 70, accompanied, as Bunsen conjectures, by 1000 or 2000 dependents, followed their former kinsman into Egypt where they settled in a district called the land of Goshen. There they remained until their numbers had multiplied into two or three millions, when under the lead of Moses they revolted and quitted Egypt to conquer Canaan.

Menes was the first king of Egypt and was succeeded by 330 monarchs, of whom one, Nitocris, was a queen. None of them were distinguished, and none of them left any monuments worthy of note, except Moeris, the last of the 330, who constructed the artificial lake which bears his name. He was succeeded by Sesostris, who conquered Ethiopia and the greater part of Europe and Asia. His successors were Pheron, Proteus (who was contemporary with the Trojan war), Rhampsinitus, Cheops, Cephren, and Mycerinus. Mycerinus was succeeded by Asychis, and Asychis by Anysis, in whose reign Egypt was conquered by the Ethiopians, who held it for 50 years under King Sabacon. At the expiration of the half century, they voluntarily abandoned the country and retired to Ethiopia. The next king of Egypt was Sesthos, between whom and the first king, Menes, the priest told Herodotus, there had been 341 generations, during a period of 11,340 years. Sesthos was succeeded by 12 kings, who reigned jointly, and together built the Labyrinth, which Herodotus thought surpassed all the works of the Greeks. After the lapse of some years, Psammetichus, one of the 12 kings, dethroned the others and made himself sole sovereign of Egypt. He was succeeded by Nechos, Psammis, and Apries, the last of whom Herodotus calls the most prosperous king that ever ruled over Egypt. But in the 25th year of his reign a rebellion broke out which was headed by Amasis. Apries was defeated and put to death and Amasis became king. Amasis was succeeded by his son Psammenitus, at the very beginning of whose reign, 525 B. C., Egypt was invaded and conquered by the Persians under Cambyses.

Cambyses treated Egypt with considerable moderation, but after an unsuccessful expedition against the Ethiopians, lost his reason, stabbed the bull Apis, and committed various atrocities. His successor, Darius I., governed Egypt with more prudence; but Xerxes I. and Artaxerxes I., had successively to reduce it to subjection, which they did in spite of assistance rendered to it by the Athenians. The 27th dynasty of the Persians was followed by another Saite line, the 28th, who still held ground against the Persians; the 29th, Mendesian dynasty of Nepherches and Achoris, maintained a Greek alliance; and the 30th, Sebennytic, consisted of Nectanebes I., who successfully resisted Pharnabazus and Iphicrates; of Teos, who employed Agesilaus; and of Nectanebes II., who fled into Ethiopia before the Persians (340 B. C.). In 332 B. C., the Persians were driven out by Alexander the Great, with whom begins a new period, the Greco-Roman, in the history of the country.

When Alexander's army occupied Memphis the numerous Greeks who had settled in Lower Egypt found themselves the ruling class. Egypt became at once a Greek kingdom, and Alexander showed his wisdom in the regulations by which he guarded the prejudices and religion of the Egyptians. He founded Alexandria as the Greek capital, and this city became the great center of commerce and Greek civilization that it long continued to be. The court of the Ptolemies became the center of learning and philosophy; and Ptolemy Philadelphus, successful in external wars, built the Museum, founded the library of Alexandria, purchased the most valuable manuscripts, engaged the most celebrated professors, and had the Septuagint translation made of the Hebrew Scriptures, and the Egyptian History of Manetho drawn up. His successor, Euergetes, pushed the southern limits of his empire to Axum. Philopator (221-204 B. C.) warred with Antiochus, persecuted the Jews, and encouraged learning. Epiphanes (204-180 B. C.) encountered repeated rebellions, and was succeeded by Philometor (180-145 B. C.) and Euergetes II. (145-116 B. C.), by Soter II. and Cleopatra till 106 B. C., and by Alexander (89 B. C.), under whom Thebes rebelled; then by Cleopatra Berenice, and Alexander II. (80 B. C.), and Neos Dionysus (51 B. C.), and finally by the celebrated Cleopatra. After the battle of Actium (31 B. C.) Egypt passed into the condition of a province of Rome, governed always by a Roman governor of the equestrian, not senatorial rank. The Egyptians had continued building temples and covering them with hieroglyphics as of old; but on the spread of Christianity the older religions lost their sway. Now arose in Alexandria the Christian catechetical school, which produced Clemens and Origen. Monasteries were built all over Egypt; Christian monks took the place of the pagan hermits and the Bible was translated into Coptic.

On the division of the Great Roman empire (337 A. D.), in the time of Theodosius, into the Western and Eastern empires, Egypt became a province of the latter, and sank deeper and deeper into barbarism and weakness. It then became the prey of the Saracens, Amru, their general, under the Caliph Omar, taking Alexandria, the capital, by assault. This happened 640 A. D., when Heraclius was the emperor of the east. As a province of the caliphs, it was under the government of the celebrated Abbassides—Harun Al-Rsahid and Al-Mamon—and that of the heroic Sultan Saladin. The last dynasty was, however, overthrown by the Mamelukes (1240), and under these formidable despots the last shadow of former greatness and civilization disappeared.

ANCIENT ARCHITECTURE.—The monuments and traces of a past civilization found in Egypt are of three periods, that of the "Great Pyramid Jeezeh," built by a previous race of people, those built in the times of the Pharaohs, and those built during the sway of the Greek and Roman rulers of the country. Although the temples of the three periods differ considerably in plan and other particulars, there is yet sound reason for believing that those built under the Greeks and Romans were constructed after designs, as they certainly occupy the sites of Pharaonic temples still more ancient than any now existing; and they were, in fact, mere restorations of temples built by the earlier Pharaohs.

The leading features of the now existing temples of the time of the Pharaohs are these: First, a gateway or pylon, flanked by two truncated pyramids. These occupy the entire width of the building, and form the entrance to a square court, surrounded by a portico supported by a double or single row of columns. Crossing this court the visitor passes through a second pylon into the inner court, which was likewise surrounded either by columns or by piers, against which were figures of the king. Beyond this second court it would appear the public were not admitted, for the spaces before the front row of columns or piers facing the gateway are occupied by a dwarf wall, which effectually barred entrance except at either one of three points where there were gates. This inner court led immediately into the largest of the temples called the Hall of Columns, the roof of which was always supported by columns representing a grove of papyrus. The center avenue was higher than the rest of the hall, and consisted usually of 12 columns, the capitals being imitated from the full-blown expanded papyrus, while the columns which sustained the lower roof were in the form of a bud of the same plant. To the Hall of Columns succeeded a series of smaller chambers, the roofs of which were generally supported by six or four columns, imitating the bud of the papyrus, either as a single plant or as several bound together; or else by square piers or columns with 8, 12 or 16 faces. These apartments frequently surrounded a dark chamber—the most sacred in the temple—the holy of holies. Whether the roof of the portico which surrounded the court was supported by piers or columns, the structural arrangement was always precisely the same. There was first the pier or column, ordinarily made of several pieces of stone solidly united by mortar and wooden clamps; then came the architrave or frieze, of one block, stretching from column to column and lastly the blocks forming the cornice, concealing the ends of the roof stones which rested upon the architrave. The bulk of the column in proportion to the weight it had to sustain, was extremely ample; and the pressure being always perpendicular, these ancient structures have come down to us with their roofs sound, while arched buildings of much less antiquity have been entirely ruined by the lateral pressure which that mode of construction exerts on the walls. The Egyptian gate was peculiarly simple. The lintel was always of one stone, and the door-posts were also very frequently of only one block, while each of the three portions had its appropriate decoration. Above the entrance was sculptured the winged globe or protecting divinity of entrances, with the names of the divinities to whom the temple was dedicated, and of the Pharaoh who built it. The door-posts also bore the name and title of the builder. The surface of each architectural feature was engraved with its particular ornament appropriately colored.

The temples built during the reigns of the Greek and Roman rulers may be thus described: First, the propylon with its truncated pyramidal towers, which were sometimes adorned with narrow flags on tall poles; then a court surrounded on three sides with a colonade. At the extreme of the court, and facing the gateway, was an elevated portico of six columns in line, and three or four deep. The uninitiated obviously were not permitted to enter beyond the court, for the columns of the first row of the portico are invariably joined by a dwarf wall, the only opening being between the center intercolumniation, to which were attached the valves of the gate. To the portico succeeded a series of small chambers, the roofs of which were supported by four or by two columns. The center chambers were lighted by small square openings in the roof, and those at the side by small openings in the walls; but in no example is there that kind of clereastory perforated with large openings that occurs in the Hall of Columns of the Pharaonic temples. Besides the foregoing characteristics, there is an elaborate form of capital, representing the papyrus in three stages of growth; in one capital, or sometimes a collection of lotus flowers, or the full-blown papyrus alone; but in no instance do we find the pier with the attached figure, nor the single bud of the papyrus, nor that form of column which represents several buds of the plant joined together. The palm tree capital, however, belongs to both periods.

Among the most remarkable structures erected by the ancient Egyptians are the great pyramids, the last thirty-seven of which were erected to serve both as monuments and as tombs. These are not to be confounded with the First Great Pyramid which was built for an entirely different purpose by a different race of people. (See further on.) Strong buildings containing one or more rooms were also erected as tombs, in which food and other articles were deposited for the use of the dead, the inner walls being embellished with inscriptions and representations, and statues of the dead being also placed in the interior. Tombs cut in the rock were also common. In connection with architecture should be mentioned the obelisks, the oldest known being erected by Usertesen I. Sphinxes, often forming avenues, were a common accessory of temples, the greatest being that known as *the* Sphnix, a colossal companion of the Great Pyramid Jeezeh.

ANCIENT SCULPTURE.—In portrait sculpture the Egyptians attained extraordinary perfection at an early date, the skill with which they worked in hard stone, such as diorite and basalt, being surprising. Some of the early statues are of colossal size, but a higher type of art is shown in those of ordinary size, though a certain conventional treatment is always apparent. The most usual kind of mural sculpture, a kind peculiar to the Egyptians, is that known as hollow or sunk relief (cavo-rilievo). The general outline of the object intended to be represented is cut into the smooth surface of the stone, while at the same time the minor forms and rotundity are represented within the incised outline. By this contrivance the details of the sculptures are protected. Sometimes the outline is excessively deep, at others the surface of the figures is altogether much lower than the general surface of the wall and in others the outline is but slightly incised with a corresponding flatness within. Wherever the Egyptians practiced the true bas-relief the sculpture is almost invariably in very low relief. The back view of the human figure is never represented in the sculptures excepting in the case of an enemy, and then rarely; the figure is generally represented in profile, and there are but few attempts at delineating the front view of the foot or of the face; however, whether the face be represented in front or side view, a profile eye is never found. The figures of the kings in battle pieces, and of the landed proprietor in domestic scenes, are always on a much larger scale than the other actors in the piece. Statues and reliefs were always painted, and when wall painting is employed it is always as a substitute for sculpture. There is no proper perspective, and certain conventionalities of color are employed. The Egyptians are represented with red and yellow complexions, red ochre for the men and yellow for the women. The hair of the king is frequently painted blue, but that of ordinary men black. In representing the various nations with whom Egypt had intercourse, the artists seem to have endeavored to imitate the complexions peculiar to each. Ammon-Re, the chief divinity of Thebes, is always painted blue, and he is further distinguished by two high feathers which he wears in his cap. The inferior divinities are not uncommonly of the complexion of mortals. The sky or heavens are invariably indicated by a strip of blue coming downward at the lower side of each extremity, and occasionally having upon it a row of five-pointed stars. Water, seas and rivers are represented by zig-zag lines of a blue or green color. Mountains have a yellow color, with red spots upon it. Egyptian art was at its highest during the period between the dynasties four and six, and notwithstanding its defects it was superior to that of Nineveh and Babylon.

ARCHÆOLOGY.—The attention of the world was drawn to Egypt as a rich field for scientific exploration in the early part of the 19th century. In 1799, M. Boussard, one of Napoleon's captains, found a large block of black granite in the trenches of Fort Julien near Rosetta; hence the Rosetta stone. On this were the remains of three inscriptions in hieroglyphic, demotic, and Greek characters. The stone was given to the British Museum by George III.

Emanuel de Rouge, of France, was the first to translate whole Egyptian books and inscriptions. His influence was felt in France by such men as Mariette, Chabas, Deveria, Pierret, Maspero, and by Revillout, the great demotic scholar of France, and by Birch, Hincks, Lepage, and Renouf in England. The practical Archæologists of the German school, notably Lepsius, Bunsen, and Brugsch, translated the texts in the Egyptian temples in their relation to history and religion. The German school has devoted itself more to grammars and philology, while the French school has made history and archæology its special study since Emanuel de Rouge's death. To Auguste Mariette (Mariette Pasha) is due the discovery of the Serapeum of Memphis. He cleared the temples of Edfu, Karnak, Denderah and Abydos. He explored the Nile valley from Tanis to Napata, and his collection of antiquities was moved in 1889 to Jeezeh from Boulak. The museum there is famous. In 1896, Col. G. E. Raum, of San Francisco, Cal., discovered the cap of the Sphnix at Jeezeh, which had been missing for centuries. After Mariette the work of excavation was carried on by Maspero, Grebaut, and De Morgan, the first who resumed his post as director-general of antiquities in 1899. There is an archæological mission in Cairo, founded in 1880 by Maspero, who placed at its head successively Lefebure, Grebaut, and Bouriant. Students go every year to Egypt to excavate. The Egyptian Research Account under Petrie trains students as explorers. The Egyptian Exploration Fund was founded in 1883 by Sir Erasmus Wilson, Prof. R. Stuart Poole, and Miss Amelia B. Edwards, and its American branch at the close of that year by the Rev. Dr. William C. Winslow, of Boston, who had spent several months of archæological research in Egypt and attended the removal of the obelisk in Alexandria for Central Park, New York. Edouard Naville, of Geneva, was the first agent sent out. In 1883 he cleared the site of Pithom, near the land of Goshen. The work of Naville, Griffith, Gardner and Newberry resulted in important discoveries at Nauceatis, Tanis, Bubastis, Tal paug, Ahnas, Denderah, Deir-el Bahari, and Telel-Amarna.

RECENT DISCOVERIES.—The last few years have seen wonderful discoveries in Egypt, for the tombs of the kings at Abydos have been opened and the treasures which have been found place us face to face with the beginnings of history. Among the remarkable finds were a carved slate slab showing King Narmer smiting his enemy, an ebony table, a bar of gold, gold jewelry, including bracelets, and a royal scepter. The oldest group of jewelry in the world is undoubtedly the four bracelets of the queen of King Zer (4715 B.C.) which were discovered with a portion of the mummy in a hole in a wall. This is 2000 years earlier than any other jewelry thus far identified. The bracelets show a wonderful perfection in the soldering of the gold. The bracelets show the turning point in the development of Egyptian art, the finest bracelets being formed of alternate plaques of gold and turquoise, each surmounted with a royal hawk. The turquoise plaques have a more archaic and lumpy form of hawk than do the gold pieces, and show that during a comparatively short period, little more than half a century, rapid crystallization in art took place, and at the end of his reign the forms are practically identical with what continued for more than 4,000 years later. Dr. Flinders-Petrie considers that this is comparable to the sudden fixation of the final forms which is seen in Greek art, where an interval of only 40 years, between the time of the Persian war and the Parthenon, sufficed for the evolution from archaic work to the greatest perfection. Each of the royal tombs had two large tombstones, bearing the name of the king, and private tombs of all the court and domestics were placed around that of their royal master. They are nearly all built of brick, in most cases with a timber lining to the chamber sunk in the ground. They were originally roofed over with beams, matting and sand. They lie about a mile back from the Temple of Abydos and they were excavated by the Egyptian Exploration Fund.

An American archæologist, Theodore M. Davies, has made one of the most interesting discoveries of recent years in excavating the tomb of one of the Pharaohs of the 18th dynasty, Thothmes IV. In this tomb was found the chariot in which Thothmes rode at Thebes. Like the other royal tombs, Thothmes' tomb consists of a gallery cut in the heart of the mountain. After sloping downward for a considerable distance it is interrupted by a deep square well, on one of the walls of which is a band of paintings. On the further side of the well the passage turns back, and finally opens into a large chamber, at the extreme end of which is a magnificent sarcophagus of granite covered with texts from "The Book of the Dead." On either side are smaller chambers, the floor of one of which was found to be covered with mummified loins of beef, legs of mutton, and trussed ducks and geese, offerings made to the dead king. Clay seals with the name of Pharaoh had been attached to the doors of the chambers, and it is stated, these seals contain proof that the Egyptians of between 3,000 and 4,000 years ago had to some extent anticipated the invention of printing, the raised portions of the seals having been smeared with blue ink before being pressed on the clay. A great many of the objects in the tomb of Thothmes were found to be broken, and this was explained by a hieroglyphic inscription on one of the paintings which adorn the walls of the vestibule to the chamber in which the sarcophagus was found. This inscription states that the tomb was plundered by robbers, but that it had been restored as far as possible to its original condition by Hor-em-heb, the reigning Pharaoh. The floor was covered with vases, dishes, symbols of life, and other objects of blue faience. Unfortunately, nearly all of them had been wantonly broken, though in some cases the breakage had been repaired in the time of Hor-em-heb. Equally interesting is a piece of textile fabric into which the hieroglyphic characters of different colors have been woven with such wonderful skill as to present the appearance of painting on linen. It is, however, of course, Pharaoh's chariot which is regarded as the great find. The body of it alone is preserved, but in perfect condition. The wooden frame was first covered with papier mache made from papyrus, and this again with stucco, which had been carved, both inside and out, into scenes from the battles fought by the Pharaoh in Syria. The art is of a very high order, every detail being exquisitely finished and the faces of the Syrians being clearly portraits taken from captives at Thebes. The chariot is, in fact, one of the finest specimens of art that have come down to us from antiquity. Along with the chariot was found the leather gauntlet with which the king protected his hand and wrist when using the bows or reins.

Recent excavations at Abydos have brought to light the royal tomb of Menes, of the first dynasty, in which was found a large globular vase of green glaze, with Menes' name inlaid in purple. Thus polychrome glazing is taken back thousands of years before it was previously known to exist. There are also several pieces of this age in the highest art of delicate ivory carving, especially the figure of an aged king, which for subtlety of character, stands in the first rank of such work, and is comparable to the finest work of Greece and Italy. This fresh connection illustrates the trade chronology of the period. A camel's head modeled in pottery takes back its relation to Egypt some 4,000 years. Hitherto no trace of the camel appeared before Greek times. The ivory carving of a bear also extends the fauna of early Egypt.

CAIRO.

(Sec. 2.) CAIRO (Arabic, El Kahira, "The Victorious," or Masr el Kahira), Egypt, capital of the country and largest city of Africa, situated on the east bank of the Nile, about seven miles above the point where it divides to form the two main branches of its delta. The town is built between the river-bank and the northwestern end of the hills known as Jebel Mokattam, on whose most advanced spur stands the citadel in a commanding position well above the rest of the city. During the last 46 years the town has lost much of its Oriental character, but the Arab quarters still present a maze of very narrow streets lined by curious buildings in endless variety of style. The houses are mostly built of yellow limestone, with flat roofs; and many of them have small gardens behind. In the more modern parts of the city the streets are broader, and many of them are lined by trees and lighted by gas. The European quarter, known as Ismailiyeh, forms the western part of the modern Cairo, and its center is the octagonal Ezbekiveh Garden (20 1-2 acres), with plants from many regions and with an artificial pond.

Here, too, are many cafes, concert halls and other similar buildings. Among the more notable buildings of the European quarter are the consulates, the opera-house, open in winter, the Italian summer theater, English and German churches, the ministerial offices and the barracks. The chief business street, known as Muski, runs east-southeastward from the neighborhood of the Ezbekiveh and the Boulevard Mehemet Ali extends from about the same place southeastward to the citadel. Cairo has more than 500 mosques, (places of prayer, Mohammedan temples or houses of worship) but many of them are wholly or partly in ruins. The finest of all is the Sultan Hasan Mosque, a truly noble building with a lofty minaret. Others worthy of mention are that built in the 9th century by Ahmed ibn Tulun in imitation of the one at Mecca; the Hakim Mosque, dating from the beginning of the 11th century; the Hosen Mosque of the son of Ali, Mohammed's son-in-law; the Sitti-Zeynab Mosque, named after a grandchild of the prophet; the Azhar Mosque, famous for its schools of theology, which are attended by Mohammedans from all parts of the world; and the Alabaster Mosque of the citadel, with the tomb of Mehemet Ali, the finest of the modern mosques. The tombs in the burying grounds outside the city, many of them in the form of mosques, also deserve mention, especially those known as the tombs of the caliphs. The most important gate of the city is the Bab-en-Nasr, through which large numbers of pilgrims pass every year on their way to Mecca. The mosques contain valuable libraries, but the chief library of the city is the viceregal one, founded in 1870, and now containing about 60,000 volumes, largely manuscript. The trade of Cairo is large and the bazaars and markets are numerous, there being special bazaars for gold and silver smiths, tapestry merchants, saddlers, armourers, shoemakers, etc. Beside the numerous Mohammedan places of worship, Cairo contains English, French, German, Coptic, and other churches and Jewish synagogues, and there are European schools and hospitals. The Egyptian Institute, founded at Alexandria in 1859, is now located in Cairo.

The suburb of Bulak, in the northwest of the town, opposite the island of Bulak, forms the port of Cairo, and its narrow streets present a busy scene of Oriental life. The island of Bulak and the left bank of the Nile are reached by a great iron bridge, and there is also a railway and general traffic bridge below the island. To the southwest of the modern town and also on the Nile bank stands the suburb of old Cairo, or Masr-el-Atika. On the left bank of the river, almost directly opposite old Cairo, is the suburb of Jeezeh. It has government buildings, a zoological garden, etc., but its chief attraction is the great Egyptological museum formerly in Bulak, but removed here in 1889. From Jeezeh a road and a tramway leads southwestward to the famous group of pyramids, called the pyramids of Jeezeh. On the island of Roda, between Jeezeh and old Cairo, the celebrated Nilometer still stands. Cairo enjoys a very mild climate, and is in consequence visited in winter by many Europeans suffering from chest and lung ailments. Many of these stay at Helwan, a small place about 14 miles south-southeast of the town. Cairo is in railway communication with Alexandria, Damietta, Suez, etc., and with Upper Egypt, and the fresh water canal connects it with Ismailia and Suez. In 1896 electric tramways were introduced in the most important streets. Cairo is the residence of the Khedive, the seat of a Coptic and a Greek orthodox patriarch, and it contains all the highest public offices of the country. El-Fostat, "tent", now Old Cairo, was founded by Amru, lieutenant of Caliph Omar, in 640 A. D. In 969 when the Fatimite dynasty gained possession of the country, the new city to the north was founded. Saladin surrounded it with walls of stone and built a citadel. He also constructed a wooden aqueduct from the Nile to the citadel, a work afterwards replaced by the still existing aqueduct of stone. Cairo was taken by the French in 1798, and was occupied by the British in 1882, after the battle of Teb-el-Kebir. Population (1907) 625,000, including Fellahin, Copts, Turks, Arabs, and other Orientals, besides about 25,000 foreigners from the chief European countries, especially Italy, Greece, France, Austria, England, and Germany.

THE SEVEN WONDERS OF THE WORLD.

(Sec. 3.) A phrase that has been applied for ages to the seven historical monuments of the constructive skill and art of the antique world. They are:

1. The Great Pyramid Jeezeh of Egypt,

the most gigantic of the three pyramids near the village of Jeezeh, about eleven miles from the banks of the Nile, forming a line to the westward of the city of Cairo. Herodotus was informed by the priests of Memphis that the great pyramid was built by Cheops, king of Egypt, about 900 B. C., or about 450 years before he visited that country; that the body of Cheops was placed in a room beneath the bottom of the pyramid; and that the chamber was surrounded by a vault, to which the waters of the Nile were conveyed by a subterranean tunnel. Pliny and Diodorus Siculus agree in stating that 360,000 men were employed twenty years in erecting this pyramid; and in contrast with this vast labor Sir John Herschel, calculating the weight of the pyramid to be 12,760 million pounds of granite (3 times that of the stone in Plymouth Breakwater) at a medium height of 125 feet, adds that it could have been raised by the effort of about 630 chaldrons of coal, a quantity consumed in some foundries in a week.

Herodotus states that 1,600 talents of silver were expended in providing the workmen with leeks, onions, and other food; and one great object of the Egyptian rulers in erecting this and other stupendous monuments was to prevent the evils of over-populousness by accustoming the lower orders to a spare diet and severe labor. It may here be sufficient to state, that the pyramid consists of a series of platforms, each smaller than the one on which it rests, and consequently presenting the appearance of steps, which diminish in length from the bottom to the top; and of these steps there are 203. The entrance is in the north face. Within are passages leading to chambers lined with granite; in one of which, the king's chamber, is a red granite sarcophagus in whch Cheops is supposed to have been entombed. This pyramid, the largest building in the world, has lost its apex and its casing. There is a second pyramid, retaining at its apex a portion of its casing, which is the tomb of Sensuphis. The third pyramid, the least ancient, was built by Mycerinus, according to Herodotus, and by Queen Nitocris, according to Manetho. The date of the pyramids is, according to the Newtonian chronology, between 1451 and 1153 B. C., or nearly 800 years after Abraham's visit to Egypt. It has been supposed by some, says Wilkinson, that from the pyramids not being mentioned in the Bible or Homer, they did not exist before the exodus, or in the time of the poet. The presence of the name of Rameses the Great (who preceded the Trojan war) sufficiently answers the latter objection. The base of the great Pyramid has been often stated to equal that of the area of Lincoln's Inn Fields; but the fact is otherwise: the base of the pyramid measures in figures 764 feet on each side; whereas Lincoln's Inn Fields, although 821 feet on one side is only 625 1-2 feet on the other, so that the area of the pyramid is greater by many thousand square feet. (The above statement regarding the "*First Great Wonder of the World*," appears in many of our modern cyclopedias. The author desires to state that the above account is scarcely correct in a single particular, and only approximately so in regard to its size. As this work is being published to particularly demonstrate the above mentioned Great Pyramid, the reader is asked to withhold his opinion until he has at least perused the closing chapter of this work.)

2. WALLS AND HANGING GARDENS OF BABYLON.

Babylon derives its name from the Hebrew word signifying Babel, the confusion of tongues (Genesis XI., 1 to 9); or from another expression signifying the court or city of Belus. In Daniel IV.-27, it is termed Babylon the Great; and by Josephus (Antiq. VIII-VI-I) the Lady of the Kingdoms; the glory of the whole earth. It was the metropolis of the province of Babylon, and of the Babylonio-Chaldean Empire. Its foundations were laid with those of the Tower of Babel. Herodotus states that the walls of Babylon were sixty miles in circumference, built of large bricks, cemented with bitumen, and raised round the city in the form of a square, protected on the outside with a ditch lined with the same material. They were 87 feet thick and 350 feet high. According to Quintus Curtius, four horse chariots could pass each other on them. The city was entered by 25 gates on each side, of solid brass and strengthened by 250 towers. The palace of Nebuchadnezzar was the most magnificent and stupendous work. Its outer wall embraced six miles. Within were two other embattled walls, besides a great tower. The hanging gardens were attributed by Diodorus to Cyrus, who constructed them in compliance with the wish of his queen to possess elevated groves such as she had enjoyed on the hills around her native ecbatana; for Babylon was flat. To gratify this wish an artificial mountain was reared, 400 feet on each side; while terraces, five in number, one above another, each containing four acres, rose to a height that overtopped the wall of the city some fifty feet, or about four hundred feet elevation. The ascent from terrace to terrace was by flights of steps; while the terraces themselves were reared to their various stages, sustained by vast arches raised on other arches and on the top were flat stones closely cemented together with plaster of bitumen and that covered with sheets of lead upon which lay the mould of the garden where there were large trees, shrubs, and flowers, and various sorts of vegetables. Mr. Rich found upon the site a hollow pier, 60 feet square, lined with fine brick laid in bitumen and filled with earth; this corresponds with Strabo's description of the hollow brick piers which supported the hanging gardens, and in which piers the large trees grew.

3. The Gold and Ivory Statue of Jupiter by Phidias at Olympus.

The masterpiece of Phidias, the greatest artist that ever lived, was executed by him for the people of Elis, and rivalled his celebrated statue of Minerva in the Parthenon. The Jupiter was set up in the temple of that deity at Olympia, near Elis, where the Olympic games were celebrated. The temple was 68 feet in height, 95 in width, and 230 in length. Pausanias describes the statue from personal observation, which Strabo corroborates. The god was formed of gold and ivory, 58 feet in height, seated on a throne, and almost touching the roof of the temple. Upon his head was an olive crown; in his right hand he bore a winged figure of Victory, also of gold and ivory, crowned and holding a wreath. In the god's left hand he bore a lofty sceptre surmounted with an eagle. His sandals and robe were of gold, the latter painted with animals and flowers, particularly lilies. The throne was formed of ivory and ebony, inlaid with gold, set with precious stones, and sculptured with graceful figures. The faces of the steps bore bas-reliefs of classic myths, and the footstool rested upon four couchant lions. In this work Phidias followed Homer's impersonation of the god:

> "He spoke, and awful bends his sable brows,
> Shakes his ambrosial curls, and gives the nod,
> The stamp of fate, and sanction of the god;
> High Heaven with trembling the dread signal took,
> And all Olympus in the center shook."

The heathen historians tell us that Phidias received for his skill the testimony of Jupiter himself; when the artist prayed the god would make known if he was satisfied, immediately the pavement of the temple was struck by lightning, and the spot was afterwards marked by a bronze vase. Crowds flocked to Elis to behold this wonder; and in Greece and Italy it was held as a calamity to die without seeing it. Nor was the admiration merely the superstition of the multitude; for a Roman senator, when looking at this Jupiter of ivory and gold, had his mind moved as though the god were present. The able restoration of this figure has been learnedly commented on by M. Quatremere de Quincy.

The Doric temple in which this statue was placed was in the extreme length 369 feet, breadth 182 feet, as traced by Mr. Cockerell, from the foundation; many of the blocks of marble weigh nearly nine tons each and each of the two remaining capitals is computed to weigh more than twenty-one tons. These masses were raised 70 feet, and the flutings of the columns would contain a man in their hollow as in a niche. The pediments were sculptured with the wars of the Giants and the siege of Troy; upon the entablature stood a row of Atlantes, each 25 feet high, and supporting an upper entablature at 110 feet above the floor. The chest of one of these giants restored measured more than six feet. The nave of the temple was 18 feet higher and 2 feet broader than the nave of St. Paul's Cathedral, in London. Of this splendid edifice the basement alone remains.

4. The Temple of Diana of the Ephesians.

At Ephesus (the modern Natolia), the capital of the twelve Ionian cities in Asia Minor, was built around the famous image of the goddess. This edifice was burned down on the night in which Alexander was born by an obscure person named Eratostratus, who thus sought to transmit his name to posterity. Alexander made an offer to rebuild the temple, provided he was allowed to inscribe his name on the front; which the Ephesians refused. Aided, however, by the whole of Asia Minor, they erected a still more magnificent temple, which occupied them two hundred and twenty years. Pliny describes it as 425 feet long by 225 broad, and supported by 127 columns, furnished by that number of kings, each column was of Parian marble 60 feet high, and weighed 150 tons, and was contributed by some prince; thirty of them were richly carved. Chersiphron was the architect. The altar was the work of Praxiteles. The famous sculptor, Scopas, is said to have chiselled one of the columns. Apelles contributed a splendid picture of Alexander the Great. The temple was built of cedar, cypress, and even gold; and within it were treasured offerings to the goddess, as paintings, statues, etc., the value of which almost exceed computation. Nero is said to have despoiled the temple of much of these treasures; but it continued to exist until it was burnt, 356 B. C.; again rebuilt and again burnt by the Goths, A. D. 262, during the reign of Gallienus, A. D. 254-268.

Vitruvius considers this temple as the first edifice in which architecture was brought to perfection, and the first in which the Ionic order was employed. Soon after it was rebuilt with additional splendor. Its remains consist of several walls of immense blocks of marble, in the fronts of which are small perforations wherein were sunk the shanks of the brass and silver plates with which the walls were faced. Some of the vast porphyry columns of the front portico lie prostrate upon the site; others were taken by Constantine to build his new city at Constantinople. The heathen temple was also dilapidated to erect the Christian church of Santa Sophia, in which these columns again support an anti-Christian edifice.

"But," says the Rev. Dr. Walsh, the traveller, "the most interesting circumstance of this building to me is, the great illustration it gives to the Acts of the Apostles. Here is the place where St. Paul excited the commotion among the silver and brass smiths who worked for the temple; and over the way was the theater, into which the people rushed, carrying with them Caius and Aristarchus, Paul's companions. Hence they had a full view of the front of the temple which they pointed out as that 'which all Asia worshipped'; and in their enthusiasm they cried out, 'Great is Diana of the Ephesians to whom such a temple belongeth.' "

5. The Mausoleum, or Tomb of Mausolus, King of Caria.

This king, the eldest of the three sons of Hecatomnus, the wealthiest of the Carian dynasty, died B. C. 353; when his widow and sister, Artemisia, erected to his memory, at Halicarnassus (now Budrun) a superb tomb, which, by its artistic celebrity, has given the name of mausoleum to tombs and sepulchres of stately character. The tomb of Mausolus was designed by Phiteus and Satyrus; it was nearly square in plan, 113 by 93 feet; around its base was a peristyle of 36 Doric columns, said to have been 60 feet high, while the superstructure rose in a pyramidal form to the height of 140 feet. To adorn its sides with sculpture, Artemisia employed Bryazis, Timotheus, Leochares, Scopas, Praxiteles and Pythis. Artemisia died before the monument was completed; when the artists are said to have finished the work for their own honor and the glory of art. Mr. Vaux, in his admirable work, "Handbook of Antiquities in the British Museum" says, "Strabo in the first, Pausanias in the second, Gregory of Nazianzus in the fourth, Constantine Porphryogenitus in the tenth, and Eudosia in the eleventh centuries, respectively speak of it in terms which imply that it was still existing during those periods; while Fontanus, the historian of the siege of Rhodes, states that a German knight, named Henry Schelegelhott, constructed the citadel at Budrun out of the Mausoleum," and decorated its walls with the marbles and bas-reliefs. The existence of these marbles had long been known, when, in 1846, they were, through the exertions of Sir Stratford Canning, presented by the Turks to the British nation, and are now in the British Museum, which thus possesses fragments of two of the seven wonders of the world—the Mausoleum, and a fragment of the casing of the Great Pyramid of Egypt. That the bas-reliefs now in the Museum were inserted in the Budrun walls by the Knights of Rhodes, is proved by the escutcheons, Latin sentences, and the date 1510, as well as by an inscription on a shield borne by one of the figures. The marbles consist of 11 slabs, 64 feet 11 inches long, sculptured with a battle between the Greeks and Amazons, Heracles, too, appearing among the combatants. The sculptures in style considerably resemble the Choragic monument of Lysicrates at Athens. There were between the columns, statues of Parian marble; at each angle of the basement a portico, surmounted with a colossal equestrian statue; bas-reliefs on the terraces; two octagonal towers on the second terrace, which was planted with cypresses, and from the third terrace, rose the crown of the pyramid, with a colossal group in marble of Phæton in his quadriga. When Anaxagoras saw this costly work he exclaimed, "How much money is changed into stone."

The Mausoleum seems to have existed in the time of Strabo and from its description by Pliny has been modeled the steeple of St. George's church, Bloomsbury, London.

6. The Pharos of Alexandria.

So named from the island on which it stood, was surrounded by water (a watch tower or light house). It consisted of several stories of galleries of a prodigious height, with a lantern at the top continually burning. It was built by Ptolemy Philadelphus, King of Egypt, about 270 B. C., and the architect, as the inscription stated, was Sostratus Onidius. How long this structure stood is not very certain but was so famous that all light houses after it were called by the common name of Pharos. "The modern Pharos" according to Mr. Land, "is a poor successor to the ancient building erected by Sostratus Onidius, though from a distance it has a rather imposing appearance. Several Arab historians mention the telescopic mirror of metal which was placed at the summit of the ancient Pharos. In this mirror, vessels might be discerned at sea at a very great distance. El Makreezee relates that part of the Pharos was thrown down by an earthquake in the year of the Flight (A. D. 793-4); that Ahmad Ibn-Tooloon surmounted it with a dome of wood and that an inscription upon a plate of lead was found upon the northern side, buried in the earth, written in ancient Greek characters, every letter of which was a cubit in height and a span in breadth. This was perhaps the inscription placed by the original architect, and which, according to Strabo, was to this effect: "Sostratus Onidius, the son of Dexiphanes, to the protecting Gods for the sake of the mariners." It is also related by Es-Sooyootee, that the inhabitants of Alexandria likewise made use of the mirror above mentioned to burn the vessels of their enemies by directing it so as to reflect the concentrated rays of the sun upon them. The Ancient Pharos was 450 feet in height and its cost was 800 talents, or $13,656,000.

7. THE COLOSSUS OF RHODES.

In the days of its prosperity, the Island of Rhodes is said to have been adorned with 300 statues and upward of 100 colossal figures; of the latter, there was one distinguished as "the Colossus of Rhodes." It was erected with the spoil which Demetrius left behind him when he raised the siege which he had so long carried on against the city. This famous colossus was erected at the port of Rhodes, 300 B. C., and consecrated to the sun, tutelar deity of Rhodes. It was, according to Pliny, a work of Chares, of Lindus, one of the cities of Rhodes, a pupil of Lysippus; its height was seventy cubits (about 105 feet), the cost of its erection about 300 talents, silver (about $477,000) and the time consumed in it about 12 years. Fifty-six years after its completion (244 B. C.) this statue was thrown down by an earthquake, and in Pliny's time it was still lying on the ground, a wonder to behold. Few persons, he says could embrace the thumbs and the fingers were longer than the bodies of most statues; through the fractures were seen huge cavities in the interior, in which immense stones had been placed to balance it while standing. Bigenaire and Du Choul, two antiquaries of the 16th century, imaginatively describe the statue to have been placed across the harbor of Rhodes, with a stride of fifty feet from rock to rock. Vessels passed under it in full sail, a lamp blazed in its right hand and an internal spiral staircase led to its summit and round its neck was suspended a glass in which ships might be discerned as far off as the coast of Egypt. After the overthrow of the Colossus, Greece and Egypt offered to contribute large sums to restore the figure, but the Rhodians declined, alleging that they were forbidden by an oracle to do so and the fragments of the statue lay scattered on the ground until the Saracens became masters of the island—a period of nearly 900 years. In the year 655, an officer of the Caliph Othman collected the valuable materials and sold them to a Jewish merchant of Edessa, who is said to have laden 900 camels with the brass.

THE GREAT PYRAMID JEEZEH

(Sec. 4.) Through the aid of a map or globe containing the different grand divisions of the earth, any person can trace for themselves the different continents and islands, and note their relative positions to each other, also those who keep themselves posted on current events know that every now and then an island sinks into the sea, or a mountain subsides to the level of the valley in which it is located; or, *vice versa*, an island or a mountain is thrown up on some portion of the earth, and we are led to remark, "it has come to stay." But it requires a little greater stretch of imagination to *think* and *say* that the North Pole has some day been the South Pole and that the east side has faced the setting sun at different intervals; or, still more wonderful to say, that such a continent was once an ocean, or such an ocean was once a continent. Yet evidence exists on the top of nearly every mountain, by the presence there of shells and fossil fish, that they once inhabited the bottom of the sea. It is not quite so clear, however, or susceptible of proof, that an ocean had once been a continent and the scene of even greater human activity than now exists on land elsewhere. This we believe nevertheless, and further on will state our reasons for such belief.

For a change of polarity we offer as evidence the fact that fossils of the polar bear, walrus, etc., have been found at points near the equator, and in portions of both the north and south temperate zones. On the other hand, not only the fossils of tropical animals, but the entire carcass of the mastodon, elephant and camel have been found in the polar regions and adjacent territory. We have not time here or space to note even the principal discoveries of the different species, with day and date. During the summer of 1862, however, we assisted in the unearthing of a mastodon's tusk at or near Kincaid Flat, Tuolumne County, Cal., that measured over 14 feet in length, and over 10 inches in diameter at the root. At this place snow falls nearly every winter and the mercury goes down below the freezing point. Also note the tracks of the elephant on the floor of the yard of the state prison at Carson, in the State of Nevada, and then say, if you think that such animals ever *voluntarily* inhabited such territory. Noted geologists estimate that it took over 40,000 years to form the mineral covering of the tracks of both human beings and animals in the Carson prison yard. While on this subject we note the fact that no fossils of animals or birds indigenous to any *cold* climate have ever been found within a radius of fifty miles of the Great Pyramid, and the stratums of rock and earth lay as originally formed, straight and level with the surface of the earth, thus proving that no general seismic disturbance or cataclysmal upturning of the earth has occurred there, at least, since the advent of man. An explanation for the cause of this phenomena will be given further on.

While the *Great Pyramid Jeezeh* is the theme to which we are directing your attention in this work, and as the clearness with which we shall herein describe it depends our success as a writer and thinker, we must first give you a condensed history of all the pyramids collectively; the better to be able to segregate the only one upon which we desire to rivet your attention.

Some authorities assert that there are from fifty to one hundred pyramidal structures scattered throughout the length and breadth of Egypt, but as Professors Howard Vyse, John Taylor, and Piazzi Smyth state in their different writings that there are but *thirty-eight*, and a number of them are only so in name, we append the list (see next page), and feel confident that the statement will prove to be a correct one. After a study of over thirty years on this mysterious subject, we are firmly convinced that there is but one perfect pyramidal structure now standing on the face of the earth, and that is what is now known as the "Great Pyramid Jeezeh"; the other 37 are mere imitations, not one of which has been built with a perfectly square base, nor do they stand facing the cardinal points of the compass; further, no one of the last 37 pyramids has been built with any two of their sides sloping at the same angle. Neither has any one of them been constructed entirely of stone, but are filled in with both brick and earth. One thing may be depended upon, however, and that is, that the last 37 pyramids were all built for one and the same purpose, *viz.*—to be the final resting place for the remains of the ruler (be they King, Queen, Emperor or Empress) that ruled over Egyptian territory at or about the dates as mentioned in the statement in table on next page.

We shall use the names of the different pyramids in this work as chronicled by the principal writers on this subject, but at the same time hold to a belief within that their builders may have called them by any other name. You will notice in the preceding table that the first nine pyramids are named Jeezeh, and are known numerically; the name Jeezeh, as applied here, is derived from the village of that name (Jeezeh or Geezeh), located in the vicinity of Jeezeh Hill and within a few miles of the location of the first nine of the Egyptian pyramids. The same reasoning may be indulged in for those pyramids standing near Abooseir, Saccara, Dashoor and Biahmoo.

TABLE OF THE PYRAMIDS OF EGYPT, all standing in the Libyan Desert, but bordering close on the Western side of the Nile Valley.

All of which are situated between 29°17′ and 30°4′ N. Lat. and 31°1′ to 31°50′ E. Lon.

Number.	Name of Pyramid.	Ancient Vertical Height in English Inches.	Ancient Base-side Length in English Inches.	Angle of Rise of the Faces to horizon, from Howard Vyse	Rude approximation to the absolute Date of Erection.
					Yr's B. C.
1..	Great Pyramid of Jeezeh.......	5,835.08	9,165.72	51° 51′ 14″	2,170
2..	Second Pyramid of Jeezeh....	5,451.	8,493.	52° 20′ 0″	2,130
3..	Third Pyramid of Jeezeh......	2,616.	4,254.	51° 00′ 0″	2,130
4..	Fourth Pyramid of Jeezeh.....	1,562.	2,562.	in steps	2,130
5..	Fifth Pyramid of Jeezeh.......	1,250.	1,718.	52° 15′ 0″	....
6..	Sixth Pyramid of Jeezeh.......	1,700.	2,187.	in steps	....
7..	Seventh Pyramid of Jeezeh....	1,562.	2,490.	52° 10′ 0″	....
8..	Eighth Pyramid of Jeezeh.....	1,562.	2,180.	52° 10′ 0″	....
9..	Ninth Pyramid of Jeezeh......	1,328.	1,953.	52° 10′ 0″	2,100
10	So-called Pyramid of Aboo Roash, a ruined commencement only, and never an actual Pyramid either in shape, mathematics, or tombic use........	(ruins about * 625.)	4,875.	no casing.	x
11.	Pyramid of Zowyat El Arrian..	* 860.	2,109.	ruins only	2,100
12	Pyramid of Reegah, with two successive slopes	1,328.	1,562.	75° 20′ 0″ 50° 00′ 0″	....
13..	Northern Pyramid of Abooseir.	2,031.	3,281.	51° 42′ 35″	....
14..	Middle Pyramid of Abooseir...	2,056.	3,281.	51° (?)	....
15..	Great Pyramid of Abooseir.....	2,734.	4,375.	52° (?)	....
16..	Small Pyramid of Abooseir...	564.	1,094.	60° (?)	2,050
17..	Pyramid 1 at Saccara..........	* 781.	†2,650.	rub'ish only	2,050
18..	Pyramid 2 at Saccara..........	1,875.	2,578.	52° (?)	....
19	Great Pyramid, or Pyramid 3 at Saccara	2,405.	4,875.	73° 30′ 0″ in steps	2,050
20..	Pyramid 4 at Saccara..........	* 781.	†2,890.	ruined	....
21..	Pyramid 5 at Saccara..........	* 547.	†2,812.	ruined	....
22..	Pyramid 6 at Saccara..........	* 937.	†3,375.	ruined	....
23..	Pyramid 7 at Saccara..........	* 469.	†2,187.	ruined	....
24..	Pyramid 8 at Saccara..........	*1,094.	†3,437.	ruined	....
25..	Pyramid 9 at Saccara..........	* 859	†3,360.	ruined	2,000
26	Pyramid base, or mere pyramidal platform, of Mustabat el Pharaoon.................	720.	3,750.	in steps	1,950
27	Northern Brick Pyramid of Dashoor	2,586.	4,062.	51° 20′ 25″	1,950
28	Northern Stone Pyramid of Dashoor	4,111.	7,500.	43° 36′ 11″	....
29	Southern Stone Pyramid of Dashoor, with two successive slopes.....	4,029.	7,187.	54° 14′ 46″ 42° 59′ 26″	......
30..	Small Pyramid of Dashoor.....	1,250.	1,875.	50° 11′ 41″	....
31	Southern Brick Pyramid of Dashoor	3,208.	4,062.	57° 20′ 2″	1,900
32..	Northern Pyramid of Lisht....	*1,093.	†4,687.	ruined	1,900
33..	Southern Pyramid of Lisht....	* 937.	†6,250.	ruined	....
34	The False Pyramid, or that of Meydoon, flat-topped and in steps; well built as mere masonry, but not as a monumentalization of angle, the casing-stones being inclined to the horizon	1,562.	2,265.	74° 10′ 0″	1,850
35..	Pyramid of Illahoon..........	*1,718	†4,922.	ruined	....
36..	Pyramid of Howara...........	*2,812	3,700.	ruined	....
37	Pyramid 1 of Biahmoo, with two successive slopes	937.	1,560.	63° 30′ 0″ 50° (?)	......
38	Pyramid 2 of Biahmoo, with two successive slopes	937	1,560.	63° 30′ 0″ 50° (?)	1,806

* Present height of ruins, about. † Present length of base line of ruins.

Pyramid Number 2 is located about 600 feet (in a S. W. direction) from the southwest corner of the Great Pyramid and Pyramid Number 3 is situated about 2,300 feet away from the Great Pyramid, in the same direction. The other Jeezeh pyramids are located still further away.

All modern Egyptologists assert that the floor condition of the King's Chamber in the Great Pyramid precludes the possibility that any stone sarcophagus could have ever been decently, and in order, established there. In the second and third Jeezeh Pyramids, on the contrary, the subterranean rooms *were* finished, floors and all, and sarcophagi *were* introduced. Their architects, moreover, attempted to adorn those chambers with a large amount of complication, but it was only useless and confusing without any very sensible object; unless it was to allow a second king to make himself a burial chamber in the Pyramid cellar already occupied by a predecessor, and then it was bad. Gradually, therefore, as the researches of Col. Howard Vyse have shown, on the fourth, fifth, sixth, seventh, eighth and ninth Jeezeh Pyramids (all these being, moreover, very small ones) the native Egyptians exhibited their utter inability to imitate in any particular the parts of the Great Pyramid, except the one single, partly descending and partly horizontal passage, with a subterranean chamber at its further end. This chamber they furnished with a flat, smooth floor, in their own manner, and not in the Great Pyramid manner, using thereupon for burial purposes; and that use they kept to, so long as they practiced their petty pyramid building at all (down to, perhaps, 1800 B. C.) most religiously.

(Sec. 5.) EARTHQUAKES AND CATACLYSMS.—As the disrupting of the surface of the earth by earthquakes and other causes have much to do with our theory regarding the reason for placing the Great Pyramid Jeezeh in its present location, and not somewhere else, we now proceed to discuss that subject. Before doing so, however, it might be well to define, or outline, our *entire position*. We have intimated in our "preface" that we believe and assert, that it was built by a race of people that preceded our race, with knowledge superior to that of any living human being today; but we have not intimated the purpose for which it was built, nor about when it was built. The last cataclysm of any importance, which sank the continent that connected Central and a portion of South America with the land that once occupied the surface of the Atlantic Ocean from the Equator to the Arctic Circle, occurred at least 50,000 years ago and the Great Pyramid Jeezeh was built at *least* 5,731 years previous to that date for the purpose of an "Initiatory Asylum" of the "*Architects, Builders and Masons*," who, in their day, ruled the world in every particular from the moral to the political and educational. As a consequence it became the depository of National Weights and Measures. To lead up to this "theory" we will first take up the "location" of the Pyramid. It is situated in the center, and at the same time at the border, of the sector-shaped land of Lower Egypt, in the *geographical center* of the whole world, and about 9 miles south of west of Cairo, the present capital of Egypt, on the west bank of the Nile river, in 29° 58′ 51″ N. lat. and 31° 10′ 1″ E. long. Theory for placing this remarkable structure there and not somewhere else is: That so long as the earth stands, does not disintegrate, or fall back into the sun (which it will do sometime in the next 10,000,000 years) it will stand and answer every physical question that mathematicians can ask or mathematics can solve, and the builders of this phenomenal structure knew it when they placed it there and why (?) Because they had lived through and were the result of a civilization that had extended back for thousands of years and had reached a state of enlightenment and civilization such as we are coming too, and may possibly reach, in the next 25,000 years; progressing at the same increased ratio that we have exhibited in the past fifty years. It is not strange that the principal writers who have investigated this remarkable stone building should have concluded that the architects and builders were *deified*, placing the date of its erection when they did, in 2170 B. C., which was about the most primitive period that "sacred history" gives us any account of. For a 100,000 years to have elapsed between the visit of Cain to the land of Nod, and Noah completing the Ark, was not dreamed of in their researches and we have lost the benefit of their most valuable scientific investigations from their dwarfed biblical interpretation. The *scientist* critic will smile and query as to what became of all this enlightened race (?) and where are the relics of their history? The answer is: That they and their history lie buried beneath five hundred feet of chalk at the bottom of the Atlantic and adjacent waters, with the single exception of the Great Pyramid and its monitor, the Sphinx, that stand as a sermon incorporated in stone to tell the story.

The weakness of our imagination precludes any attempt on our part to paint a written picture of the intelligence of this ancient race of people, which (for the lack of a more appropriate name) we will call them the "*Atlanteans*." That they had constructed other pyramids, castles and domes and spires, together with the building of great cities, we feel confident of. That they not only knew all that we now know, but that they successfully navigated the air, could temper copper harder than steel, knew the exact circumference of a circle, the distance to all the fixed planets, and could overcome gravitation. Further, that they had solved the social and political problems—they were all of one mind.

They knew the north pole and the south pole as perfectly as we know the equatorial region. With such knowledge and ability, they naturally posted themselves upon all the geographical changes of the different continents and islands. They knew all it was possible for human beings to know about earthquakes, cataclysms, the procession of the equinoxes, etc. With such knowledge, they must have arrived at the conclusion that, as every portion of the earth above water had some day been beneath the waves, and that possibly every portion then covered by water, had at some previous time been dry land, the very wise men of those days came together and debated something after this manner: "Although we are now on dry land, and we and our fore-fathers have been for over 25,000 years, yet this land beneath our feet will again become the sea and that sea in time again become a continent although thousands of years may have to elapse to accomplish it. It is self evident that different races of people have preceded our race but they have left nothing behind them to last long enough for a new race created after them to come up and see and know. Let *us* not be so thoughtless." They further argued: "The principal land of the whole earth once surrounded the south pole, but that was over 750,000 years ago, when it sank—leaving only a few thousand little islands scattered south of the equator, the principal continents coming to the surface then, are those we are now enjoying; extending as they do from a few degrees south of the Equator northerly and easterly, reaching through the North temperate and frigid zones, and surrounding the North-pole. The central or pivotal point of which, is located (at this time) near the Tropic of Cancer, in 29° 58′ 51″ N. Lat. and 31° 10′ 1″ E. Lon.; and as a consequence is the center of all the land of the Earth, and will continue to be for the next 600,000 years; although portions of it will continue to rise and fall at intervals of from 13,000 to 26,000 years, the central portion will not be perceptibly disturbed by any earth movement for over 600,000 years." (About 500,000 years from 1907 A. D.) They therefore resolved to immediately visit that spot, and erect thereon one of their Initiatory Asylums and General Depositories of Weights and Measures; this they did, and it stands today, and is known to us as the *Great Pyramid Jeezeh.*"

SUBMERSIONS AND EMERSIONS OF THE EARTH DURING THE CARBONIFEROUS AGE AND OTHER PERIODS.—Referring to the cause of the apparent many submersions and emersions that parts of the earth (dry land) have undergone, geological changes, which cause is not absolutely certain, it has been supposed by some scientists, that the precession of the equinoxes and the motions of the earth's axis (or poles of the earth) caused a part of the waters of the globe to change places periodically about the surface of the earth (or once in about each 13,000 years). Or at least this is the time required for the equinoctial points of the earth to move half way around the ecliptic. (See cut "Changes of the Seasons.") The latitude of places is said not to be changed or affected by the precession of the equinoxes. Prof. Pepper in his "Playbook of Metals," says it is "stated that when Cæsar invaded Britain, more than 1900 years ago, that the site of London was then in latitude 40° 30′, whereas now it is in latitude 51° 28′." Mr. Pepper further states that "wines were formerly made of the grapes grown in the open fields of England, and that the remains of elephants are found in abundance in Siberia." To which we would say that it is pretty certain that the waters of the earth have moved about the globe, caused either by the motion of the earth's axis or by the shortening and crimping of the earth's diameter from time to time, or by both of these causes; for much of the dry land of the earth has been submerged periodically, or this operation occurred many times all through the period of the deposits of the carboniferous age—and it is very probable that it has taken place periodically during all time of the earth's existence, and it might have happened from the cause of the motion of the earth's axis during the carboniferous age, and from other causes since that time—or from the shortening of the earth's diameter from time to time during all ages—as there are few if any persons who can study the subject of Geology, especially the carboniferous period and formation, without coming strongly to the conclusion that much of the dry land of the earth has been submerged at many different times during the deposits occurring during said carboniferous age. The very regularity with which the submergence occurred in many cases through that age and the coal measures, would indicate to some extent that the cause was invested in the motion of the earth's axis during that period of time. There is no doubt but parts of the dry lands of the globe have been submerged from time to time by the bending and partial doubling up of the earth's crust and strata—but we must confess that we see no chance for the apparent regularity of submersions and emersions to occur so regularly by the shortening of the earth's diameter—as there is or appears to be by the earth's axis motion process. This motion of the earth's axis is such that the north pole at this time appears to describe a circle about the northern heavens, which has a diameter of 47° across it, once in about each 26,000 years, which is about the same length of time that it takes the equinoxes to fall back 360 degrees by precession. These axis and precession motions may have affected the latitudes of places and affected the submersions of dry land from time to time during the carboniferous and coal measure age and ceased to have such effects since that period. In many coal stratums there is very distinct pause—partings occurring every eighteen inches or two feet, or seldom exceeding thirty inches without such a pause parting with more or less impurities in the seams between the layers of coal, which (layers) are generally from fifteen to twenty or twenty-four inches thick, or a little more or less, and these layers lying within the main coal bed (or beds) itself.

It has been estimated that it requires about 40,000 years to grow vegetation enough to constitute a stratum of coal four feet thick, but it appears to us that in a warm and somewhat moist or wet climate that enough vegetation (calamites) may grow up and fall down each year to compose a ton of coal to the acre in a coal stratum and this would give us a coal bed between two and three feet thick in about 5,000 years, but if the vegetable accumulations occurred at only about half this rate we would have such a bed of coal in about 10,000 years. The deposits of coal (beds) are numerous in some coal fields and they are laid down, together with their coverings, tolerably regular in places, and appearing as though they had been produced or affected in their positions by some tolerably regular motion or movements of the earth.

The carboniferous formation is from nothing to a few feet thick in places and from this ranging from hundreds of feet to 15,000 or 20,000 feet thick in other parts, which (20,000 feet) is possibly about one-third of the solid contents of the earth's crust, and most of this comprises a movable mixture of mud, sand, gravel, limestone, magnesia, clays, marls and some primary and secondary rocks and animal and vegetable matter. There is in this thickness in some parts about eighty stratums of coal of various thicknesses, each of which must have been covered up in its turn through the process of the submergence of the earth through probably some of the causes named above. There are some reasons to suppose that the earth has not been free from submersions, or some other somewhat violent disturbance, long enough for vegetation sufficiently abundant to grow to form or compose a workable stratum of coal since the close of the carboniferous age.

Much of the silurian strata appears to have been deposited under water, as its layers are found tolerably even bedded in most places or where it has not been disturbed by convulsions. But on rising and approaching the carboniferous formation we come in contact with great accumulations of movable matter or strata. It is in and through the period from the lower silurian to the top of the carboniferous or coal measures that much of this heavy sedimentary matter was deposited, and it appears to be during the latter part of this same time that the earth's crust commenced more forcibly to bend and yield to the heavy deposits of this matter that had accumulated on and about different parts of the earth's surface or in its seas and valleys. *Prof. R. Mansill* asserts: "since the inauguration of the coal measures and carboniferous formations the earth's crust has grown greatly thicker and denser and the waters have accumulated about the valleys and the tropics, and it is the volatility and activity of these waters that maintains a higher temperature about the tropics than there is about the poles of the earth. The volatile expansive force of these waters absorbs currents of electricity from both poles of the earth and from the sun to support the expansion of these volatile waters with, which waters are converted into vapors, and this again chills the poles of the earth, and also increases the elevation of temperature about the tropics while it decreases it about the poles. The increase of a higher temperature about the tropics and a decrease of temperature about the poles commenced with the increased thickness and increased density of the earth's crust; and this process will continue so long as the earth's crust continues to grow thicker and denser. Therefore the difference of temperature between the tropics and poles is a local or earthly cause and not (strictly) a solar cause at all. The idea of philosophers attributing so much potency to the sun by saying that that body radiates heat (so-called) and fills all solar space by spontaneous emission, and can raise a temperature about the earth's equator so high (80 to 90 degrees of temperature) at a distance of 91,840,000 miles, but can not warm the earth's poles, which are only about 6,000 miles from its tropics, is rather degrading, we think, to the present age of scientific philosophy." Or we may add: why does the snow not melt on the tops of the high mountains, even in the tropics? *See explanation in another part of this work.* It appears to us that the inhabitants of some parts of this globe are in more danger from a sinking and crimping and submergence of the earth's crust, than from a burning up of the globe, which doubling of strata would still be apt to shorten the earth's diameter to some extent and back its ocean waters over valleys and lowlands, as it apparently has done from time to time since the commencement of the carboniferous period, and these (submerging) periods have apparently been growing shorter and shorter between such convulsions since the close of the coal measures period.

PERMANENCE OF CONTINENTAL AREAS.—Prof. Lyell, in his "Manual of Geology" speaks of the permanence of continental and oceanic areas as being somewhat permanent, or that the present configuration of the earth's surface has been pretty well maintained, or the present lands, mountains and oceans have gradually come into existence moderately and naturally through long periods of time, or without the whole mass being jumbled and mixed up together so that they could not be classified and divided into sections and recognizable divisions and ages, as they have been or as they are at this time. There is no doubt in our mind but the quantity of oxygen in the atmosphere surrounding the earth has always been limited during the time of the construction of the earth up to this date, and those elements, as previously stated, having the strongest absorbing power for oxygen would take possession of it and unite with it in about the same order as their uniting and absorbing forces take place with that element at this time—therefore, through the carboniferous age, carbon appeared to have the greatest absorbing power for oxygen, hence its very great prominence and influence throughout that long period of time. There is no doubt but some of the upper silurian, much of the devonian and carboniferous limestone formations, excepting those under and near to the coal measures, were contemporary in growth with much of the deposits of the lower coal measures, as the juices from the decaying vegetation of the early coal epoch supplied the beaches with rich carbonaceous juices that generated the lower orders of animal types and life, and these juices and the low orders of this small animal life, or such as that which we find in and from the upper silurian to the coal measures, or such as the coccosteus, pterichthys, cephalaspis, holophychious, osteolepis, and a few other species of the devonian and mountain limestone formations."

EARTHQUAKES.—The regions that are at present comparatively free from sensible earthquakes are: Egypt, the eastern and southern portion of Africa, northern Europe and Asia, Australia, Easter Island, eastern portion of South America, Greenland, and northern portion of North America. The least vibrations, however, and the lightest are those experienced in and around Cairo, Egypt. Earthquakes are recorded, however, as having occurred in Cairo, in 1301 A. D., also in 1856, and in 1874 A. D., but there is no record extant for the last 10,000 years that a single stone was disturbed, or an ounce of material displaced in or around the Great Pyramid Jeezeh; and this state of tranquility, we predict, will continue in that locality for 500,000 years to come.

THE EARTHQUAKE ZONE (so considered) around the earth is: Central America, the West Indies, the Azores, Italy, Syria, Persia, Afghanistan, Tibet, Japan and Hawaiian Islands.

As the theory expreesed by Prof. David, of Sydney, regarding the inside formation of the earth, and his views on the cause of earthquakes, or some of them, so nearly coincide with our own, we with pleasure copy the following article from the San Francisco *Daily Chronicle* of September 28, 1906:

"It is my firm belief that the earth is composed in the manner of an egg, with three different homogeneous substances. The outer, or the crust of the earth corresponds to the shell of the egg, then there is a softer, perhaps gelatinous substance which corresponds to the white of an egg, and in the center of the earth is still another which is like the yolk of an egg." These are the words of Professor T. W. Edgeworth David, of Sydney University, Australia, one of the world's great geologists, who is at the St. Francis. Professor David has just returned from attending the National Congress of Geologists at Mexico City. He has traveled around the world and read papers before the Royal Society in London. While there he came in contact with Professor Milne, one of the great earthquake experts, and was led to believe the new theory as expounded by Milne.

SAYS PROOF IS EASY.—"The proof is easy and simple and the idea is a complete departure from former theories of the earth's interior," said Professor David, his eyes shining with excitement. "It has come to Milne as the result of life long experiments with earthquakes and motion of the earth. The proof is adduced from the lines of the seismograph during an earthquake shock which results in the destruction of buildings, that is, one of extraordinary violence. If the lines of the seismograph during such a shock are examined it will be found that they are divided into three sets of curves. The shock begins with very slight vibrations, suddenly these are increased to about twice the length without any gradual transition. After these have continued there comes another equally sharp increase in which the lines become about twice the length of those preceding. It is during the last period of the shock that buildings are wrecked. It is from the study of these lines that Milne has arrived at the theory which has astounded the scientific world."

MILNE FATHER OF THEORY.—"Milne was the first man who saw the value of studying earthquakes, and brought scientific treatment to the subject. He noticed at once this similarity in all impressions of the siesmograph, and thought there must be some reason for the three sets of vibrations. Then he investigated. He found that the slight vibrations continue about 10 degrees from the center of the shock. Then the next set begins and continues about 120 degrees from the center of shock, then the third set start and are heaviest at that point directly opposite the center of shock.

"If the earth is represented by a circle drawn on a paper, and a point is marked as the center of shock, then if ten degrees are marked off along the circumference, it will be found that the distance from this arc to its chord is about thirty miles. In other words the crust is thirty miles thick. Then as soon as the vibrations get through the crust, they strike the white of the egg, and the first quick jump comes. It is found that the substance under the crust of the earth takes up about four-tenths of the diameter on each side, and the inside substance corresponds to the yolk of the egg. It is supposed that the substance immediately under the crust of the earth is softer than the crust, and that when the vibrations reach it, the crust rises and falls on it in much the same manner of a ship on the water. This accounts for the waves in the ground familiar when earthquake shocks are in progress. It seems to me beyond a doubt that the theory is a true one and will have a great effect on science, as it will revolutionize the theory of wave motion. The whole lecture, in which Milne expressed this great theory, took only about six minutes."

We do not know Prof. Milne's theory beyond that as expressed above, so what we may add are our own crude ideas. Our ideas coincide with the Professor regarding the three different conditions inside of the crust of the earth, but he does not go far enough. We would compare the earth in shape to that of an average apple, being shortest the long way. With the earth, we believe the polar diameter to be at least 20 miles shorter that the equatorial diameter, and that this condition is caused by the fluid condition of the third, or yolk compartment, inside this flattened, egg shaped earth of ours. If the earth was solid to its center, no velocity given its perimeter would flatten it at the poles, and increase its equatorial diameter, as is the case with the earth today. Conceding this point, then of what does this inner fluid consist? We believe it consists of all the heavier metals—not only of those with which we are familiar but metals with such excessive specific gravity that they have never been thrown to the surface of the earth. We firmly believe that there is enough gold in a molten state, in the center of the earth that would make a globe the size of our satellite, the moon. A feather of proof to substantiate this theory is: that gold is found in greatest quantities at the extreme ends of continents; we believe it was thrown there in a molten state, during a cataclysm or sudden changing of the poles of the earth. Finding gold in large quantities elsewhere, is proof to us that the ends of continents have been in different positions, in past disturbances of this same character. In future polar changes, continents may be expected to change accordingly.

Between 8,000 and 10,000 earthquakes have been chronicled by different publishers since the year 1606 A. D., as follows: "The Earthquake Catalogue" of the British Association, contains between 6,000 and 7,000 earthquakes that occurred from the year 1606 down to 1842 A. D.; the "Catalogue of Earthquakes" compiled by Perry, and published by the "Belgian Royal Academy" bring the list from 1842 down to 1872; and from 1872 down to June 30, 1905, may be found in the different editions of the Statistician and Economist, published between the year 1876 and 1905.

We believe that a surprise is in store for even the most careful student of seismology, in the following carefully prepared list of all important earthquakes that have occurred since the Christian Era to date.

(Sec. 6.) EARTHQUAKES. — The following is a list of some of the principal earthquakes and volcanic eruptions that have occurred since the Christian era, with the loss of life, no account being taken of the property destroyed, which is variously estimated at from $100,000 to $10,000,000 for every 100 lives lost. Records exist of many convulsions of nature having occurred in the past, where millions of dollars worth of property have been destroyed and not a life sacrificed, *viz.*, at New Madrid, Mo., on December 16, 1811, and continued with more or less vibration for 54 days; portions of the country sunk, islands were formed in the Mississippi, and $20,000,000 would not cover the loss.

YEAR.	PLACE.	PERSONS KILLED.
17	—(A. D.) Ephesus and other cities overturned	Thousands
63	—Pompeii	Hundreds
79	—(Aug. 24) Total destruction of Pompeii, Herculaneum and Stabiæ (eruption of Vesuvius)	280,000
105	—Four cities in Asia, 2 in Greece, and 2 in Galatia overturned	Many thousands
115	—Antioch destroyed	....
126	—Nicomedia, Cæsarea, and Nicea, dest'd	Thousands
157	—In Asia, Pontus, and Macedonia 150 cities and towns injured	....
358	—Nicomedia again destroyed	....
543	—Universal; felt over the whole earth	....
557	—Constantinople, Turkey, over	15,000
560	—In South Africa, many cities injured	....
742	—In Syria, Palestine and Asia, over 500 towns destroyed (estimated) loss of life	400,000
801	—Heavy loss of life in Fran., Ger. and Italy	....
936	—Constantinople again overturned, all Greece shaken	....
1089	—Severe throughout England	....
1114	—Severe at Antioch, many towns destroyed	....
1137	—Cantania, Sicily	15,000
1158	—In Syria, etc.	20,000
1268	—Cilicia, Asia Minor	60,000
1274	—Felt over England, Glastonbury destroyed	....
1318	—(Nov. 14) In Eng., greatest known to date	....
1456	—(Dec. 5.) At Naples	40,000
1509	—(Sept. 14) At Constantinople	Thousands
1531	—(Feb. 26) At Lisbon, 1500 houses buried, nearby towns engulfed, loss of life	30,000
1580	—(April 6.) In London; part of St. Paul's and Temple churches fell	....
1596	—(July 2) In Japan; several cities made ruins, loss of life over	10,000

YEAR.	PLACE.	PERSONS KILLED.
1626	—In Naples; 30 towns ruined, loss of life over	70,000
1638	—(March 27) Awful at Calabria	....
1647	—(May 13) Santiago, Chile	4,000
1667	—(April 6) Ragusa ruined	5,000
1667	—Also at Schamaki, lasted 3 mos	80,000
1672	—(April 14) At Rimini over	15,000
1690	—(Oct. 17) Severely felt in Dublin	....
1692	—Total destruction of Port Royal, Jamaica, (June 7) houses engulfed 40 fathoms deep	3,000
1693	—(Sept.) In Sicily, 54 cities and 300 villages overturned; in Cantaria, of 18,000 inhabitants, not a trace could be found; loss	100,000
1703	—(Feb. 2) Aquila, Italy	5,000
1703	—Jeddo, Japan ruined	200,000
1706	—(Nov. 3) In the Abruzzi	15,000
1716	—(May and June) At Algiers	20,000
1726	—(Sept. 1) Palermo, Sicily, Italy	6,000
1731	—(Nov. 30) Pekin, China	95,000
1732	—(Nov. 29) In Naples, Italy	1,940
1746	—(Oct. 28) Lima and Callao, Peru	18,000
1751	—(Nov. 21) Port-au-Prince, St. Domingo	Thousands
1752	—(July 29) Adrianople, European Turkey	Thousands
1754	—(Sept.) At Grand Cairo	40,000
1755	—(April) Quito, Ecuador, destroyed, over	30,000
1755	—(June 7) Kaschan, N. Persia, destroyed	40,000
1755	—(Nov. 1) Great earthquake at Lisbon, Portugal, (50,000) extending over 5,000 miles, from the Madeira Islands to Scotland. Total loss of life over	70,000
1759	—(Oct. 30) In Syria; Baalbec destroyed	20,000
1767	—(August) At Martinico, W. I	1,600
1773	—(June 7) In Guatemala, great loss; Santiago, Chile swallowed up over	50,000
1778	—(July 3) At Smyrna, Asia, very destructive	....
1780	—At Tauris (15,000 houses destroyed) engulfs	45,000

YEAR.	PLACE.	PERSONS KILLED.
1783—(Feb. 5)	Messina and many towns in Italy and Sicily destroyed; life loss......	Thousands
Note.—The earth was not perfectly quiet from earthquake tremors, in Calabria, S. E. Italy, from 1783—1787, a period of four years, during which period thousands of lives were sacrificed, and millions of dollars of property destroyed.		
1784—(July 23)	Erzengan, Armenia...........	5,000
1788—(Oct. 12)	At St. Lucia, W. I...........	900
1789—(Sept. 30)	At Borgo di San Sepolcro....	1,000
1794—(June)	In Naples; and Torre del Greco, Italy, overwhelmed, over..............	10,000
1797—(Feb. 4)	Quito, Ecuador; Cuzco, Peru, and Panama almost totally destroyed......	41,000
1800—(Sept. 26)	At Constantinople, Turkey, destroyed the Royal Palace...........	Hundreds
1805—(July 26)	At Frosolone, Naples.........	6,000
1810—(August 11)	At the Azores; a town of St. Michael's sunk, and a lake of boiling water appeared in its place................	....
1811—(Dec. 16)	San Juan Capristrano, Cal....	50
1812—(March 26)	Caracas, Venezuela..........	12,000
1819—(June 16)	District of Kutch, India, sunk	2,000
1819—	Throughout Italy, thousands perish......	....
1822—(Aug. 10 and 13 and Sept. 5)	Aleppo, Syria	22,000
1822—(Nov. 19)	Coast of Chile permanently raised from 1 to 12 miles wide................	....
1828—(Feb. 2)	Island of Ischia, severe........	28
1829—(Mar. 21)	Murcia and other towns in Spain	6,000
1830—(May 26–27)	Canton, China, and vicinity	6,000
1835—(Feb. 20)	Concepcion, Chile, destroyed, over	20,000
1835—(April 29)	Cosenza, Calabria; etc........	1,000
1835—(Oct. 12)	Castiglione, Calabria..........	100
1839—(Jan. 11)	Port Royal, Martinique.......	700
1840—(Feb. 14)	At Ternate, total destruction	Thousands
1840—(July 27)	Mt. Ararat, Armenia......over	800

YEAR.	PLACE.	PERSONS KILLED.
1842	—(May 7) At Cape Haytien, St. Domingo	5,000
1851	—(Feb. 28 and March 7) At Rhodes and Macri	600
1851	—(April 2) Valparaiso, Chile, 400 houses..	....
1851	—(Aug. 14) Melfi, Italy..................	14,000
1853	—(Aug. 18) Thebes, Greece, nearly destroyed	....
1854	—(April 16) St. Salvador, S. Am., destroyed	....
1854	—(Dec. 23) Anasaca, Japan, and Samoda, Niphon, destroyed....................	....
1855	—(Feb. 28) Broussa, Turkey, destroyed.....	....
1855	—(Nov. 11) Jeddo, Japan, nearly destroyed	....
1856	—(Mar. 2) Volcanic eruption on Great Sanger Island........................	3,000
1856	—(Oct. 12) In the Mediterranean; at Candia and Rhodes, etc...	750
1857	—(Dec. 16) In Calabria,* Montemurro, and other towns of Naples............... (*From the year 1783 to 1857, a period of 75 years, the Kingdom of Naples lost over 111,000 inhabitants by earthquakes.)	10,000
1858	—(Feb. 21) Corinth nearly destroyed.....	....
1859	—(Mar. 22) At Quito, Ecuador...........	5,000
1859	—(June 2 and July 17) At Ezeroum, Asia Minor, thousands perish...............	....
1860	—(Mar. 20) At Mendoza, Argentine.......	7,000
1861	—Mendoza, South America..............	12,000
1862	—(Dec. 19) Guatemala; 150 buildings and 14 churches; some lives................	....
1863	—(April 22) Rhodes; 13 villages..........	300
1863	—(July 2 and 3) Manila, P. I............	1,000
1865	—(July 18) At Macchia, Bendinella, and Sicily; 200 houses and life loss..........	64
1867	—(Feb. 4) Argostoli, Cephalonia..........	50
1867	—(March 8 and 9) At Mitylene...........	1,000
1867	—(June 10) Djocja, Java,; town destroyed	400

1868—(Aug. 13–15) Arequipa, Iquique, Tacna, and Chencha, and many towns of Peru and Ecuador destroyed; loss $300,000,000 and 30,000 rendered homeless; life loss......	25,000
1869—(Dec. 28) Santa Maura, Ionian Islands	17
1870—(Oct. 9–15) In Calabria, several towns destroyed..............................	......
1872—(March 26–27) Inyo County, Cal., 1,000 shocks in 3 days and 7,000 to April 4th, life loss..............................	34
1872—(Dec. 14–15) At Lehree, India..........	500
1873—(Mar. 19) San Salvador, Cen. America..	50
1873—(June 29) At Feletto, Northern Italy, etc.	75
1874—(July 22) At Azagra, Spain, land slip....	200
1874—Antigua, etc., Guatemala; great life loss....	....
1875—(May 3–5) Kara Hissar, etc., Asia Minor great destruction of life...............	....
1875—(May 12) At Smyrna, Asia Minor, over	2,000
1875—(May 16–18) At San Jose de Cucuta, etc., Colombia, South America..............	14,000
1877—(May 9–10) Callao, Peru, and other towns destroyed by tidal wave, life loss slight..	....
1878—(April 14) Cua, Venezuela, nearly destroyed	300
1879—(June 17) Cantania, Sicily, 5 villages destroyed; loss of life slight.............	10
1880—(July 4–24) Several killed in Switzerland, and Manila, P. I.; cathedral destroyed	3,000
1880—(Sept. 13) At Valparaiso and Illapel, Chile	200
1880—(Nov. 9) At Agram, Croatia, many lives..	....
1881—(Jan. 27 and Mar. 3) Much damage in Switzerland..........................	....
1881—(Mar. 4 and 15) Severe in S. Italy; at Casamicciola, Isle of Ischia..............	114
1881—(April 3) Chios (now Scio) Greek Archipelago, and several other towns..........	4,000
1882—(Mar. 13) In Costa Rica, thousands of lives lost; very destructive................	....

YEAR. PLACE.	PERSONS KILLED.
1882—(Sept. 7–10) Panama R. R. partly destroyed	....
1883—(June 14) During a severe shock of earthquake, a mountain rose up to an elevation of 6,000 feet, near Chernowitz, Austria	....
1883—(June 15) On Ometepe Island, Nicaragua, volcanic outbreak; over	500
1883—(July 28) At Casamicciola, Ischia; 1990 known victims and estimated unknown loss of life 2,000 more; total	3,990
1883—(Aug. 27) Beginning at midnight, Aug. 26, on the Island of Krakatoa, but simultaneously extending to every island and portion of the sea for over 100 miles in either direction, 30 square miles of the island sank in less than three hours; tidal waves reached as far as the Cape of Good Hope; lowest estimate loss of life	50,000
1883—(Oct. 8) Eruption of Mt. Augustine on the Island of Chernaboura, Alaska; one half of the island and mountain sunk and in the vicinity a new island rose	8
1883—(Oct. 16) Anatolia, coast of Asia Minor, Ischesne, and 30 small towns devastated; 30,000 destitute	1,000
1884—(May 19) Asiatic shore of Sea of Marmora, and Island of Kishm	220
1884—(Dec. 25) In Andelusia, Malaga	266
1885—(Jan. 14) Beginning Dec. 26, 1884, in Alhama, Grenada, South Spain, including 14 other towns, with loss of 20,000 houses, value $100,000,000; life loss alone was	3,900
1885—(Feb. 28) In province of Grenada	690
1885—(April 20) In Java	500
1885—(May 13-31) At Strinagur, Cashmere, 7,000 dwellings and life loss	3,081

YEAR. PLACE.	PERSONS KILLED.
1885—(June 15-30) At Sopar, India	700
1885—(July 31) In Asia Minor	350
1885—(Aug. 2) In Vernoe and Tashkend, Central Asia	54
1885—(Dec. 3-5) In villages of Algeria	30
1886—Aug. 27) In Greece and Ionian Islands; Prygos destroyed; life loss	1,300
1886—(Aug. 31) Atlantic States, chiefly at Charleston, S. C., three-fourths of that city destroyed; 17 shocks, life loss	96
1887—(Jan. 15) Long continued earthquake at Tokio, Japan	....
1887—(Feb. 23) Severe shocks, extending from Milan, Italy, to Marseilles, France; there were 12 deaths on French territory and 2,000 in Italy	2,012
1887—(April 7-8) Mendez Nunez and San Francisco, Cavite, P. I., terribly shaken; life loss	170
1887—(May 5) In Hawaii	167
1887—(June 10) Town in Turkistan destroyed	125
1887—(Announced June 13) At Avernoe and Almatensky, Turkistan, nearly destroyed	140
1887—(Dec. 4) Destruction of Bisignano and Cosenza, in Calabria, S. E. Italy; very destructive	25
1888—(March) At Yunan, China	4,000
1888—(July 15-18) Destruction of the peak Sho-Bandai-San, in Japan. This mountain had an altitude of 6,000 feet and 3 miles through its base; but in less than 10 minutes over half of its cubic contents were scattered over an area of 27 square miles	400
1889—(Jan. 11) Earthquake felt throughout the State of New York	....
1889—(April 13—14) On Ishima Island, Japan	170

YEAR.	PLACE.	PERSONS KILLED.
1889—(Sept. 8)	Earthquake at Florence, Wis., damage $15,000	....
1890—(Dec. 12)	Village of Joana, Java	12
1891—(Jan. 15)	At Gouraya and Villebourg, Algeria, villages nearly destroyed	40
1891—(Same day)	In Chihuahua, Mexico	15
1891—(Aug. 18)	Earthquake and cyclone devastate the Island of Martinique; life loss	340
1891—(Sept. 8–13)	In San Salvador very violent	40
1891—(Sept. 26)	Shocks severe throughout the states of Mo., Ill., Ky., Tenn., Ind. and Ia.	....
1891—(Oct. 28)	Very destructive earthquake on the Niphon Islands, Japan; 1,477 shocks followed within 3 days; 166442 houses and bridges were destroyed; property loss over $10,000,000; life loss	7,524
1891—(Dec. 18)	Violent earthquake in Sicily	....
1892—(Jan. 22)	—Severe earthquake shocks in Rome, houses wrecked and lives lost in the Italian provinces	....
1892—(Jan. 27)	Severe shocks experienced in New South Wales, Victoria, and Tasmania; some loss of life	....
1892—(Feb. 17)	Vesuvius (Vol.) again in activity fears of a new crater	....
1892—(July 30)	Every building destroyed in San Cristobal, Mexico	....
1893—(Jan. 13)	Earthquake at sea causes a tidal wave that floods Paumoto group of islands near Tahiti; loss of life over	1,000
1893—(Jan. 31)	Zante, Greece, suffered greatly by earthquakes, from the close of January to April 21; while less than 100 lives (are quoted as) lost, thousands were rendered homeless, and over $3,000,000 is reported as the property loss	....

YEAR. PLACE.	PERSONS KILLED.
1893—(Feb. 13) At Quetta, Afghanistan, many injured; killed	2
1893—(April 8) Two villages destroyed in Servia 3,000 houses wrecked at Milattia, Asia Minor; the killed	130
1893—(April 18) Earthquake and tidal wave at Zante, Greece; the ground opened 2 feet wide and sank 1 foot; every house ruined, 200 persons injured; killed	30
1893—(May 5) Mt. Ætna active, repeated shocks throughout Italy, extending to the Isle of Man	......
1893—(May 22) Shocks, with ground opening at Thebes, Greece	......
1893—(May 28) Shocks cause the jail to collapse and prisoners are crushed at Guayaquil, Ecuador	......
1893—(Aug. 11) Destructive shocks with loss of life at Mattinata, Italy; Vol. Stromboli in eruption; over	1,000
1893—(Nov. 17) Terrible earthquake at Kuchan, Persia; 50,000 animals perish, human life loss over	12,000
1893—(Nov. 19) At Samark and Asiatic Russia, severe; life loss over	1,000
1893—(Nov. 27) At Montreal, Canada; great loss to property	......
1894—(Mar. 17) Earthquakes on Isthmus of Tehuantepec, Mexico; very severe, and extend to Europe and Asia; again on April 6 doing much damage	......
1894—(April 20) Earthquakes in Greece destroy 11 towns; the life loss over	300
1894—(April 28) Earthquake destroys 6 cities in Venezuela, one-half the population killed, over	3,000

YEAR.	PLACE.	PERSONS KILLED.
1894	—(July 10–15) Shocks at Constantinople, Turkey, and vicinity cause a property loss of $29,000,000; life loss over	1,000
1894	—(July 27) Earthquakes destroy many houses in Servia and Bulgaria and a considerable number of lives	......
1894	—(Aug. 8) Severe throughout Sicily, killed	10
1894	—(Oct. 16) Volcanic eruptions on Ambrym Island, New Hebrides; life loss	60
1894	—(Oct. 21) Eruption of Mt. Galoongong, Java, causes the destruction of many villages	......
1894	—(Oct. 22) At Sakata, Japan, 3,000 houses destroyed; life loss	360
1894	—(Oct. 27) Earthquakes throughout the Argentine Republic. City of San Juan almost totally destroyed; 20,000 persons rendered homeless; life loss	2,000
1894	—(Nov. 7) Eruption of volcano followed by 63 shocks covers the Island of Epi, New Hebrides, with ashes	......
1894	—(Nov. 13) Ambrym, New Hebrides, nearly destroyed; life loss	50
1894	—(Nov. 16) At Messina, Italy; killed	200
1894	—(Nov. 22) In the City of Mexico much property, and a life loss of	15
1894	—(Dec. 5) Continuous shocks since Nov. 27 throughout Ecuador; many people killed and injured	......
1894	—(Dec. 29–31) Throughout Italy much property destroyed	......
1895	—(Jan. 17) Earthquakes at Kushan, Persia, 127 shocks, city completely levelled, thousands killed; over	10,000
1895	—(Feb. 5) Earthquake at Molde and Bergen Norway; life loss	11

YEAR.	PLACE.	PERSONS KILLED.
1895—(Feb. 22)	Destruction of Koutchat, Persia, life loss exceeded	10,000
1895—(April 3)	At Tuscany, Italy; killed	27
1895—(April 30)	Volcano Colima, in State of Colima, Mexico, becomes active	....
1895—(May 18)	Severe shock in vicinity of Florence, Italy; great destruction	....
1895—(Aug. 1)	At Krasnovodsk, Russia	120
1895—(Sept. 8)	Earthquakes and volcanic eruptions in vicinity of Metapan, Honduras; property loss $600,000; life loss	300
1895—(Sept. 18)	Lava flow from Mt. Vesuvius, Italy, blocks the roads	....
1895—(Nov. 1)	Violent shock damages much property in Rome, Italy	....
1895—(Dec. 3)	Volcano Vesuvius in Italy, active	....
1895—(Dec. 26)	Earthquakes in Samoa beginning on the 25th, at Tutuil^, for 24 hours the shocks were incessant; at Fagolia Bay a submarine geyser was produced; no loss of life	....
1895—(Dec. 29)	Many houses wrecked at Cicciano, Italy, several persons killed	....
1896—(Jan. 2)	Earthquakes in Khalkhal District, Persia; life loss over	1,100
1896—(Jan. 3)	Volcano Kilauea, H. I., active; a burning lake over 200 feet square and 250 feet deep formed in 6 hours	....
1896—(Feb. 12)	Shock of great severity at Colon, Colombia	....
1896—(Mar. 2)	Violent shock at Colima, Mexico; very destructive	....
1896—(April 20)	Eruption of the Volcano Mauna Loa, Hawaii; the glow is seen 180 miles away	....

YEAR. PLACE.	PERSONS KILLED.
1896—(June 15) Earthquake and tidal wave on the Island of Yeddo, Japan; 9,616 houses destroyed, resultant wave felt in Hawaii; 1,244 persons wounded; life loss........	37,150
1896—(July 11) Volcanic eruption of Kilauea, Hawaii, after one and one-half years quiet	....
1896—(July 13) Shock felt at Whitby, Ontario, lasting 20 seconds..................	....
1896—(July 26) Earthquake, causing tidal wave, devastates coast of Kiangsu province, China; property loss millions, life loss over	4,000
1896—(Aug. 26) Earthquake in Northern Japan, wrecks 6,500 houses; life loss...........	3,500
Recurring in the same section (on Aug. 31) 1,000 houses overturned and a life loss of	120
1896—(Sept. 13) Severe shocks felt at Hilo, Hawaii, the earth opened from the sea inward for half a mile..................	....
1896—(Oct. 4) Earthquakes in Iceland, ruin 150 farms; large numbers of live stock killed	....
1897—(Jan. 11) Earthquake on Kishm Island, largest in the Persian Gulf; life loss......	2,500
1897—(Feb. 14) Destructive earthquake at Girau, Formosa, and throughout the island; injured 120; killed....................	56
1897—(Mar. 23) Severe shock at Montreal, Quebec	....
1897—(April 23) Severe shocks lasting a week, in the Leeward Islands; at Monserrat the killed exceeded......................	700
1897—(May 11) In S. Australia 90 shocks in 3 days; much damage done at San Gabriel, Jalisco, Mexico.....................	....
1897—(June 4) Eruption of Vesuvius, lava flow one and one-eighth miles wide, greatest since 1872........................	....

YEAR.	PLACE.	PERSONS KILLED.
1897—(June 12)	Earthquake in Assam and other provinces of India, lasted *continuously over 5 minutes;* life loss over...........	6,000
1897—(June 20)	Shocks destroy every building in Tehuantepec, Mexico; 15,000 people homeless.........................	....
1897—(June 22)	Eruption of Volcano Mayou, Albayo, P. I.; life loss.................	120
1897—(Sept. 18)	Severe shocks are felt in Turkistan, Asia, and throughout Switzerland	....
1897—(Nov. 8)	Eruption of Vesuvius; fearful flow................................	....
1897—(Dec. 28)	After a great fire in Port-au-Prince, Hayti, an earthquake followed leaving great fissures around the city....	....
1898—(Jan. 13)	Earthquake on Dutch Island of Amboyna, kills......................	60
1898—(Mar. 28)	Earthquake in New Hebrides Islands, cause many gaps in the earth	....
1898—(Aug. 7)	Earthquake at sea, causing a tidal wave on Formosa Island, China Sea; 2,073 houses destroyed, 995 damaged; 160 persons wounded, and the killed number.	139
1898—(Sept. 10)	Earthquake at sea, causing a tidal wave in St. Vincent and Barbados, W. I., destroys Bridgetown and Kingston, with a property loss of $1,000,000 and a life loss of........................	400
1898—(Sept. 23)	Vesuvius eruption threatening; 3 lava streams descending equals 5 acres in area, 275 feet deep.................	....
1898—(Nov. 27)	Earthquake in S. Austria, also in Greece; tidal wave at Triest; life loss	28
1899—(Jan. 21)	Shock lasting 10 seconds in Jamaica, W. I., severest in years........	......

YEAR.	PLACE.	PERSONS KILLED.
1899—	(Jan. 27) Earthquakes in Greece for 4 days (continuous); 5 villages destroyed; many injured, deaths unknown	....
1899—	(Mar. 7) Terrible earthquake in the Nara Prefecture, Japan; killed	41
1899—	(April 18) Volcano Houongo active, 2 towns destroyed; earthquakes in Argentine	....
1899—	(May 17) 45 shocks in 5 hours on Island of Montserrat, Br. W. I.; houses and crops destroyed; some lives lost	....
1899—	(July 14) Earthquake near Herne, Westphalia, entombs 60 miners	....
1899—	(Aug. 9) Tidal wave at Valparaiso, Chile; awful desolation; loss $1,000,000. Also violent shocks at Corte, Corsica	....
1899—	(Sept. 20) Earthquake at Aidin, Asia Minor; life loss exceeded	1,500
1899—	(Oct. 11) Town of Amhei, Island of Ceram destroyed; injured 500, life loss over	4,000
1899—	(Oct. 16) Volcano San Martin, near Catamaco, Mexico, resumes activity	....
1900—	(Jan. 1) Earthquake in District of Achalkalak, Russia, severe; life loss	800
1900—	(Feb. 1) Unusual severe shock at Abbotsford, B. C.	....
1900—	(Feb. 15) Earthquake of great severity at Lima, Peru; immense loss of property ...	....
1900—	(Mar. 27) Eruption in Mt. Baker district, Washington; a hill thrown up 70 feet high in a valley and it changed the course of the Nooksack River; report heard 10 miles away	....
1900—	(April 12) Earthquake at Lindai, Japan, wrecks 70 houses	....

YEAR. PLACE.	PERSONS KILLED.
1900—(July 17) Eruption of Volcano Mt. Azuma, Japan, destroys several towns; life loss over	200
1900—(Oct. 9) Shock of great severity at Kadiak, Alaska; loss of 1 life and much property	....
1900—(Oct. 18) Earthquake and tidal wave, Island of Matapi, South Pacific, great loss of property	....
1900—(Oct. 29) At Caracas, Venezuela, destroys much property; life loss	15
1900—(Oct. 31) At Jacksonville, Fla., 8 severe shocks	....
1901—(Jan. 4) Heavy shocks of earthquake in Kans. and Mo.; hundreds seek the streets in terror	....
1901—(Feb. 14) Severe shock of earthquake at Union City, Tenn	....
1901—(Feb. 20) Earthquake at Arica, Chile, inhabitants panic stricken	....
1901—(Mar. 9) At Lima, Peru, houses cracked in every direction	....
1901—(April 2) Shocks in S. E. Hungary cause the destruction of many houses	....
1901—(April 14) Mt. Vesuvius again active	....
1901—(April 24) Severe in Italy, the inhabitants panic stricken	....
1901—(July 26) Heavy shocks over a large area of the State of Nevada	....
1901—(Aug. 16) Earthquake causes the disappearance of a mountain 500 feet high in N. Japan	....
1901—(Oct. 7) Earthquake causes a tidal wave on the Pacific side of Nicaragua; some damage	....
1901—(Oct. 30) Severe shock felt in many Italian cities; damage at Gallarate	....

YEAR.	PLACE.	PERSONS KILLED.
1901	(Nov. 8) Severe shocks in Erzeroum, Asiatic Russia	
1901	(Nov. 13) Shock at Salt Lake City, Utah, lasts 30 seconds; loss over $100,000	
1901	(Nov. 15) Terrible earthquakes visit Erzeroum, Asiatic Russia, 50 in all, 10 very violent; 1,000 houses destroyed; 1,500 damaged; 15,000 homeless, the life loss.	130
1901	(Nov. 17) At Cheviot, New Zealand, many people injured; property loss over $100,000	
1901	(Dec. 15) Shock lasting 65 seconds visits Manila, P. I.; many injured	
1902	(Jan. 16) Chilpancingo, Guerrero, Mexico in ruins; number killed	300
1902	(Feb. 14) Shamaka, Russia, destroyed; 34 villages in the Transcaucasia suffer, 4,000 houses destroyed; life loss	5,000
1902	(Mar. 8) Tchengeri, Asia Minor, destroyed 4 persons killed and 100 injured	4
1902	(Mar. 10–17) Constant vibrations for one week in New Hebrides Island; 3 volcanos active	
1902	(Mar. 12) Kyankari, Asia Minor, destroyed; known to be killed	4
1902	(April 18–20) Throughout Guatemala, 6 large towns almost obliterated; many injured; known killed	200
1902	(May 3–7) Volcano Mont Pelee, near St. Pierre, Martinique, first eruption started on May 3rd, and destroyed the Guerin factories. In four days it destroyed St. Pierre, Lecarbet, Le Precheur and La Mare; the loss of property was $40,000,000 number of lives	30,000
1902	(May 18) Violent shocks in Southern Portugal, caused by upheavals in W. I.	

YEAR.	PLACE.	PERSONS KILLED.
1902—(July 13–30)	Violent earthquakes throughout Venezuela on the 13th. Severe shocks in Kingstown, St. Vincent, on the 18th, and again on the 21st, the sea receding. On the 30th the Volcano Poas, near Alajuela, Costa Rica, became active. On the same date every building in San Cristobal, Mexico, was destroyed. Many lives were lost.	....
1902—(Aug. 14)	Volcano overwhelms Island of Torishima, Japan; life loss	150
1902—(Aug. 21)	Eruption of Mont Pelee, Martinique, very severe, total darkness for 20 minutes; also 12 shocks at Zamboanga, P. I., several Moras killed.	....
1902—(Aug. 22)	Eruption of Mont Allomonte, Italy; also severe shocks at St. Petersburg Russia	....
1902—(Aug. 30)	Volcano at Masaya, Nicaragua, becomes active	....
1902—(Dec. 6)	Daily shocks, last 9 days in S. E. Iowa	....
1902—(Dec. 16)	Adijan, Russian Central Asia, destroyed; 9,130 houses and 19 cotton gins destroyed; the killed numbered	4,800
1902—(Dec. 27)	Earthquake at Hain Chiang, China, causes a life loss of	600
1903—(Jan. 13)	Earthquake at sea causes tidal wave that floods Paumoto group of islands near Tahiti; life loss over	1,000
1903—(Jan. 14)	Earthquakes do much damage in States of Tamaulipas and Tobasco, Mexico	....
1903—(Feb. 7)	Summit of Volcano Mt. Pelee, changes shape, Martinique	....

YEAR. PLACE.	PERSONS KILLED.
1903—(Feb. 24) Violent eruption of Mt. Colima, Mexico; Mexican Cen. R. R. extension stopped...........................	....
1903—(Mar. 3–6) Mexican Volcano Colima has violent overflows of lava; Tuxpan, Mex., panic stricken.......................	....
1903—(Mar. 9) Vesuvius again active; ashes and explosive incandescent globes reach Naples..........................	....
1903—(Mar. 15) Earthquake in the mountainous region of Montana; third in 10 years....	....
1903—(Mar. 21) Volcanos Mt. Pelee, on Martinique, and Soufriere, on St. Vincent, extraordinarily active......................	....
1903—(April 21) Earthquake at Tuxpan, Mexico, cause cave in a mine; killed.........	10
1903—(June 8) Severe shock at Alusi, Ecuador; ashes fall there from Volcano Sangai.....	....
1903—(June 22) Vesuvius in full eruption, spectacular sight from Naples, Italy..........	....
1903—(Aug. 11) Earthquakes destroy 3 villages on Isle of Cinthera....................	....
1903—(Aug. 12) Shocks at Mendoza, Argentine, destroys many houses; the killed number	5
1903—(Sept. 19) Most violent shake at Santiago de Cuba since 1895......................	....
1903—(Oct. 19) Earthquake at Turshez, Persia, destroys 13 villages; life loss was.......	250
1903—(Nov. 3) Again at Turshez, Persia; the town almost totally destroyed; life loss was over.........................	350
1903—(Nov. 29) Tidal waves sweep coasts of Hawaiian Islands; much damage done..	....
1904—(Mar. 10) Earthquakes destroy 6 Italian villages; no lives lost..................	....

YEAR. PLACE.	PERSONS KILLED.
1904—(Mar. 20) Earthquake felt from St. Johns, N. B., to Boston Mass., causes much damage, and Bald Mt., in Maine, disappears	....
1904—(April 4) Earthquakes in Macedonia destroy 1,500 houses; life loss was........	24
1904—(June 11) Volcano of Mt. Wrangel, in Alaska, in violent eruption............	....
1904—(Nov. 6) Earthquake on Island of Formosa, destroys 150 houses; life loss........	78
1904—(Dec. 1–14) Slight shocks felt at San Francisco, Cal., and near vicinity; 14 since Dec. 1st......................	....
1905—(Jan. 16) Volcano of Momotombo, Central America, active, much damage done.....	....
1905—(Jan. 18) At Shemakha, Russia, destroys bridges and kills many people..........	....
1905—(April 4) Earthquakes in India destroy much property; at Dharmsala, 470 soldiers were buried alive; total loss over	2,000
1905—(April 25) Severe earthquake at Bender, Abbas, Persia; 200 yards of Mt. Kuhgando collapsed, 50 persons buried in a landslide; shocks continued for a week, the inhabitants camped in the open........	50
1905—(May 3) Severe shock felt on Island of Hilo, Hawaii.......................	....
1905—(May 9) Very severe shocks felt in City of Mexico; some damage................	....
1905—(June 1) Earthquakes occur in Central Japan; great loss of property at Scutari and Albania where 200 persons were killed and wounded; over 500 houses collapsed; life loss over...............	2,000
1905—(June 11) Volcano Mt. Pelee, Island of Martinique, again active...............	....

YEAR. PLACE. PERSONS KILLED.

[NOTE.—Our record of the earthquakes from June 11, 1905 to April 17, 1906, were lost in the great fire that followed the great earthquake of April 18, 1906 at San Francisco, Calif., and vicinity.]

1906—(April 18) The "Great Earthquake" of 1906; *central at San Francisco, Cal.*, although extending (traceable) for over 2,500 miles; and extending from the Aleutian Group of islands in Alaska, to Lower California; must have started in the Arctic Ocean, and extended to the equator in mid-Pacific.

At San Francisco the first shock occurred at 5:14.58 a.m., by Mt. Hamilton time, and lasted one minute and five seconds. The damage wrought in that short time was immense, throwing down many buildings, and damaging (more or less) thousands; but the most disastrous results were: the great loss of life, which it is conceded exceeded (exact number unknown) 480, and the destruction of the water mains of the Spring Valley Water Co.; which left the fire department helpless to cope with the fires started by the breaking of gas mains, electrical connections, etc. The result was the almost total destruction of the city. The area burned over exceeded 2,593 acres, or 405 square miles; with a destruction of over $350,000,000 of property; insurance of about $235,000,000, of which some 80% has since been paid.

[Comparative destruction between the San Francisco, Chicago and Baltimore big fires: 1st. San Francisco; area burned, 2,593

YEAR.	PLACE.	PERSONS KILLED.
	acres; 25,000 buildings; loss $350,000,000. Date, April 18–21, 1906; known killed	480
	2nd. Chicago; area burned, 2,124 acres; 17,450 buildings; loss $206,000,000. Date, October 8–9, 1871.	
	3rd. Baltimore; area burned, 640 acres; 2,500 buildings; loss $80,000,000. Date, February 7–8, 1904.]	
1906—	(April 18) By volcanic action, an island arose from the sea in the Aleutian group, Alaska, on the morning of the above date. This latest accession to the U. S. territory is called "Perry Island"; it contains about 17 acres; its highest point is about 700 feet elevation. Four months later, it was still piping hot.	....
1906—	(May 26) *Fifty-seven* shocks of earthquake occurred at Houghton, Mich., and vicinity, during the day; buildings rocked like cradles; in several places the earth opened from 2 to 6 inches. The "Atlantic mine" had to close down for the day on account of the disturbance	....
1906—	(May 29) A severe earthquake shock was experienced at Fort de France, Martinique; which completely stopped political disturbances that were in progress throughout the island	....
1906—	(June 5–6) Three slight earthquake shocks on the 5th and a *severe* shock on the 6th, were felt in Manila, P. I. and very severe on the Island of Samar; no loss of life reported	....
1906—	(June 15) Between the hours of 9:40 and 10:35 p.m., 4 slight shocks of earthquake were felt at San Francisco and Oakland, Cal. and vicinity; no damage	....

YEAR.	PLACE.	PERSONS KILLED.
1906—(June 22)	Two severe earthquake shocks (half an hour apart) occurred in the early morning at Santiago, Cuba. While no material damage was done, it started thousands of people into the streets for the balance of the night..............	....
1906—(June 27)	Violent earthquake shocks were experienced throughout the southern portion of Wales; hundreds of chimneys fell, and some buildings. Also felt at Bristol, England. No life loss................	....
1906—(June 27)	A slight shock of earthquake was felt at Cleveland, Ohio, and along the southern shore of Lake Erie, for over 100 miles, or from Pinesville to Marblehead. Local scientists place the seat of this disturbance beneath the bed of Lake Erie	....
1906—(July 17)	Eruption of Volcano Stromboli, in Sicily; incandescent material thrown to enormous heights, causing many fires; the phenomenon was similar to that which preceded the disastrous earthquake at Calabria last autumn........	....
1906—(July 15–18)	Severe earthquake shocks, (54 in 3 days) destroyed two-thirds of Socorro, New Mexico; San Marcia and Magdalena suffer also but no life loss........	....
1906—(Aug. 2)	Four violent shocks at Fort de France, Martinique, terrorize the inhabitants..............................	....
1906—(Aug. 16)	At the John Hopkins University, Baltimore, Md., the *seismograph* was broken after registering 51 shocks, the needle jumped 3 1-2 inches sideways. (For the cause see what follows.)	

YEAR.	PLACE.	PERSONS KILLED.
1906—	(Aug. 16) The most severe earthquake (as to vibration) that has occurred for over 100 years, is recorded at Valparaiso, Chile, and other cities of that Republic. The shock began at 8 p.m. The first shock lasted 4 1-2 minutes; 2nd shock, 2 minutes; over 100 shocks followed within 24 hours; the estimated damage to property in Valparaiso, including fire was $40,000,000; at Santiago, $6,000,000; in the other eight large towns nearly destroyed, $7,000,000 and $5,000,000 more for the interior. The loss of life at Valparaiso was over 2,000; at Santiago, 55; other towns about 100; total..........	2,155
	[Over 300 looters were shot by the authorities orders.]	
1906—	(Aug. 18) Tidal wave visits the islands of Hawaii, (attributed to the earthquake at Valparaiso) it carried away a wharf in Malacca Bay, Island of Maui...........	....
1906—	(Aug. 22) Violent tremblor visits Seahorse and other towns in upper Silecia; overturning nearly everything movable	....
1906—	(Aug. 30) Violent shocks continue throughout Chile at intervals of from 12 to 24 hours, and have for the last 10 days; 5 shocks today at Tacna...............	....
1906—	(Sept. 5) Two severe shocks felt at Hilo, Hawaii, and on no other island of the Hawaiian group; caused hundreds of dead fish to be thrown up on the beaches; apparently they had been scalded......	....
1906—	(Sept. 9) The German government operator at Apia, Samoa, reported that he recorded both the San Francisco and the Valparaiso	

YEAR.	PLACE.	PERSONS KILLED.
	earthquakes on his seismograph, but that on the above date (Sept. 9) he recorded one more severe and of longer duration. As it has never been heard from, it must have been at sea..................	....
1906—	(Sept. 10) Volcanic eruption of a mountain near Kwareli, Asiatic Russia; the mountain emitted a sea of semi-liquid sand and stones, burying human beings .... alive to the number of..............	255
1906—	(Sept. 27) Severe shock of earthquake lasting 30 seconds, visited Porto Rico, and was general throughout the island; some damage........................	....
1906—	(Oct. 1) Great earthquake at sea. An earthquake (located by seismographs in different parts of the world) as occurring in the Indian Ocean; must have continued for over three hours................	....
1906—	(Oct. 16) Two violent shocks felt at Manila, P. I.........................	....
1906—	(Oct. 18) Sharp shock felt throughout Idaho and Wyoming................	....
1906—	(Nov. 10) Mount Vesuvius and the villages surrounding it, were severely shaken at noon; accompanied by a fall of ashes; three more slight shocks followed during the afternoon. Ottajano, that was almost entirely destroyed in April last by the eruption of Mt. Vesuvius, was the most severely shaken today...............	.....
1906—	(Nov. 15) Severe shocks of earthquake were general throughout New Mexico, between 2 and 4 a.m. today, extending south to El Paso, Texas. Although houses were rocked to and fro, no material damage was done........................	....

YEAR.	PLACE.	PERSONS KILLED.
1906—(Dec. 1)	Earthquakes, slight in character, but frequent, occurring at Valparaiso, Chile........................	....
1906—(Dec. 2)	The north coast of the Island of Sicily thoroughly shaken..............	....
1906—(Dec. 4)	KINGSTON, Island of St. Vincent. A prolonged earthquake was felt here tonight. It lasted fully eight seconds. The vibrations were slow. The people of Kingston were thrown into a panic. No other shocks felt here have ever lasted so long. The Island of Barbados, about 100 miles to the east, and the island of St. Lucia, about 250 miles to the northwest, also felt the shock. It was most severe at St. Lucia. There has been a continuation of earthquake shocks here at irregular intervals of varying severity since last February............................	....
1906—(Dec. 5)	TUTUILA, Samoa.—Fresh outbreaks have occurred in the volcano in Savaii, and the field of lava now surrounding the volcano is thirty square miles in extent.....................	....
1906—(Dec. 9)	At San Francisco, Oakland and Berkeley, California; a shock of six seconds duration occurred at 3:20–40 a.m. This shock was third in intensity at the two former places; and 4 or 5 at Berkeley. No damage done, but every sleeper felt it........................	....
1906—(Dec. 20)	Another portion of the crater of Mount Vesuvius fell today and caused a great eruption of ashes, cinders and sand. No detonations or earth shocks followed. But sand and ashes continued to fall for	

YEAR.	PLACE.	PERSONS KILLED.
	hours afterward as far as Naples and Pompeii.	. . . .
1906	—(Dec. 22–23) WASHINGTON, D. C.–A special bulletin issued by the Weather Bureau says: "The seismographs of the Weather Bureau recorded two earthquakes of considerable magnitude, the first shortly after noon of the 22d and the second about twenty-three hours later, namely, afternoon of December 23. From the appearance of the records we are led to conclude that the earthquakes originated at widely separated localities, but this cannot be definitely told. The first tremors were recorded at 1:51:50 p. m. of the 22d, and the maximum motion, of short duration, occurred at 2:22:40 p. m. The record ended about 3 o'clock. The strongest action was recorded in a north-south direction and amounted to 1.7 millimeter displacement of the ground. The displacement in the east-west direction was only .3 millimeters. The second disturbance was recorded just after 12 o'clock, December 23, and the motion in both north-south and east-west directions was greater in both components and lasted longer than in the first earthquake. The first preliminary tremor began at 12:37:33 p. m., the strongest motion beginning at 12:49 and lasting from three to four minutes. The maximum displacement in the east-west direction was 1.7 millimeters and 1.9 millimeters for the north-south component. The end of the record occurred at 1:11:21. As far as can be judged from	

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the records, the second disturbance was not at such a great distance as the first, but both disturbances must have been several thousand miles from Washington."

1906—(Dec. 23) BERKELEY, Cal.—The Omori seismograph at the students' observatory of the University of California recorded earthquake waves today at 9 hours 26 minutes and 35 seconds, Pacific Standard time, which indicate that a severe earthquake has occurred at a distant point. Careful measurements of the seismograph gave the following: Time of commencement, 9 hours 20 minutes 35 seconds, Pacific Standard time; duration of preliminary tremor, 1 minute 29 seconds; duration of second stage of preliminary tremor, 6 minutes 16 seconds; duration strong motion, 11 minutes 38 seconds. The motion is shown in the east and west component only. The average period of the waves was 16 seconds. Owing to the fact that the Omori seismograph is designed for recording slight shocks of nearby origin rather than heavy ones of distant origin, it is difficult to apply the ordinary rules to determine the exact distance of the origin of the shock. But it is safe to say that the origin was not less than 2300 miles nor more than 4000 miles distant. The record is very like the Valparaiso record, only not so intense. The shock occurred in the north or south, probably the south, close to the shore or in the ocean.

YEAR. PLACE. PERSONS KILLED,

1906—(Dec. 23) LONDON.—An earthquake shock of nearly three hours duration was recorded on the seismographs on the Island of Wight and at Florence. A dispatch from Kopal, in the province of Semiryetchonsk, Russian Turkistan, brings news of an extremely violent shock there at 11:20 p. m. Dec. 22, lasting ninety minutes. No details are given.

1906—(Dec. 26) A great earthquake has just visited the sea coast of Chile; extending over the entire province of Tacna, and destroying over one-half of the city of Arica. The port of Iquique, 120 miles further south, however, was not damaged.

1906—(Dec. 27) VALPARAISO, Chile.—A violent earthquake visited this place today, followed by two slight shocks in the evening and at Arica, the scene of the recent severe earthquake, caused landslides and wide fissures, but there were no deaths.

1907—(Jan. 9) HONOLULU, T. H.—At midnight the people of nearly all parts of Hawaii awoke to the realization that the splendid spectacle of an outbreak of Mauna Loa was before them. In Hawaii volcanic activity is never dreaded; it is always welcomed. It means a spectacle as long as it lasts, incomparable, magnificent—and so far as the experience of a hundred years goes, without danger to life—almost without danger to property. From the summit of Mauna Loa, a vast dome which rears itself from a base fifty miles in diameter and includes almost half of

YEAR. PLACE. PERSONS KILLED.

the Island of Hawaii, to a height of 13,675 feet above sea level, a great glow began to be seen. It rose in an immense column of light, reflecting from the overhanging clouds, and seeming to spread out over a large area of the zenith. Where the column left the mountain it seemed almost white in the intensity of light. To those who have seen eruptions of Mauna Loa, it told its own story. Somewhere near the summit of the great mountain the molten lava had broken out in a fiery stream, forming first a cone, and then, bursting through the side of this, had started as a river of fire and lava down the gently sloping side of the mountain. This wonderful spectacle was visible, as it has now been ascertained, for a distance of one hundred miles in every direction, except where great cloud banks piled by the trade winds on some parts of the mountain's shoulder, intercepted the view.

1907—(Jan. 10) A tidal wave, caused by volcanic action, has devastated some of the Dutch East Indies south of Achim. The loss is very great. It is known that 300 persons perished on the Island of Tana, and 40 were drowned on the Island of Simalu. As the latter named island has almost disappeared, it is probable that over 1500 persons were drowned............ 1,500

1907—(Jan. 14) A slight conception may be had of the magnitude of the eruption of the Volcano of "Mauna Loa," that began on Jan. 9th, at midnight, from the following

YEAR.	PLACE.	PERSONS KILLED.
	report, 5 days later, from Honolulu:—"Lava from Mauna Loa volcano is flowing down the western side at the rate of seven miles an hour in three streams. One stream has crossed the Government road and reached the sea, thirty miles from its source. Some slight damage has been done to grazing lands, but neither life nor property has been endangered. The eruption has attracted many sightseers." The second flow of lava at the end of the first week was half a mile wide and moving 720 feet a day.	
1907—(Jan. 14)	Destructive earthquake almost entirely destroying the City of Kingston, Jamaica; following in its wake by a fire which consumed over half of the city. The most conservative estimate of the loss of life is 1,000 persons. The financial loss exceeded $25,000,000	1,000
	In sympathy with the above, Mt. Vesuvius, in Naples, became more active; and Manila, P. I., was badly shaken up, and a tidal wave broke over the harbor works.	
1907—(Jan. 18)	—Two violent earthquake shocks were experienced at Kuba, Government of Baku, European Russia, at 5:30 a. m. today. Damage light. At the same hour, a severe shock occurred at Tolmezzo at the foot of the "Carnic Alps," Italy; the inhabitants were panic stricken. And in sympathy, a tidal wave of considerable proportions occurred at the entrance to Tokio Bay, Japan.	
1907—(Jan. 19)	Severe shocks (without material damage) felt at Alexandrousk, Sahkhalia and Elizabethpol, Russia.	

YEAR. PLACE. PERSONS KILLED.

1907—(Jan. 22) Two more severe earthquake shocks, and the heaviest since the "great tremblor" of the 14th inst., at Kingston, Jamaica; several more buildings were thrown down, but no one injured.

1907—(Jan. 24) Three shocks of earthquake occurred at the village of Prospect, 19 miles from Utica, N. Y., thoroughly alarming the entire population.

1907—(Jan. 30) Several severe earthquake shocks felt at Highland and Greenville, Illinois, at 11:30 p. m.; some dishes broken, loss trivial.

1907—(Feb. 22) A very severe earthquake shock occurred at Unalaska, Alaska; in sympathy at the same hour, the inactive volcano of Akutan, on Akutan Island, of the Aleutian Archipelago, started into activity. It has been inactive for several years.

1907—(Feb. 28) A strong shock of earthquake was experienced in the southern portion of Carbon Co., Wyoming, on the evening of the above date. The seismic disturbance extended as far south as Hahn's Peak and was so severe that the inhabitants were thrown into a panic. At Slater, one building was twisted a foot out of plumb.

1907—(Mar. 29) The worst earthquake experienced in over 40 years, in the Erzeroum volcanic regions occurred at 10 a. m. on the above date at Billis, Asiatic Turkey. Over 2,000 houses were damaged, from \$50 to \$500 each; 300 houses entirely demolished, and eight lives were lost. Surrounding villages suffered proportionately but as it occurred in the daytime the loss

YEAR.	PLACE.	PERSONS KILLED.
	of life was light, although many were injured.	
1907—(April 2)	An earthquake of extraordinary severity visited Canby, (and vicinity) Modoc Co., Cal.; the result was the opening of a gash of four feet in width, over a mile long. This crack seems to be bottomless.	
1907—(April 14)	The City of Mexico, and the entire coast on the Pacific, between Acapulco, Mexico, and the Isthmus of Panama, was the scene of the most destructive earthquake—in that section—known for many years. The following places were almost completely wiped out, *viz.*—Chilpancingo, Chilapa, Tixtea, Ayutla, and Ometepec. On the height of the first shock, the harbor of Acapulco, took on the appearance of a typhoon-swept ocean, and a tidal wave submerged one portion of the city of Acapulco. The whole coast from Acapulco to Salinas Cruz has been damaged. Incomplete returns show a death list of 98 persons and 300 injured from various points in Southern Mexico. Although the first shock in the City of Mexico lasted for 4 1-2 minutes, no loss of life is reported there. The property loss throughout the Republic of Mexico will run into millions of dollars. The seismographs located all over the world, including the "Weather Bureau" at Washington, D. C., designate this particular earthquake as a "record breaker." The disturbance lasted for over two hours, and indicated that it was central somewhere in the Pacific Ocean	98

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1907—(April 16–17) The "Atlantic Liner" steamer La Provence, which arrived at the port of New York, April 19, 1907, reported: "That from midnight April 16th until 5 p. m. April 17th, she passed through a storm which, the officers of the ship say, has rarely been exceeded in violence on the Atlantic. At dinner time, the 16th, the barometer began to fall rapidly and as midnight approached the ship reached an area where the air was so heavily charged with electricity that the compass became worse than useless. Suddenly a terrific storm swept down on the ship. Great waves broke over the liner's decks, but no rain fell, the night being perfectly clear. After five hours, the storm abated as suddenly as it had come. No one was injured, but the passengers were badly frightened. Captain Aliax, of the liner, believes the strange storm was the result of the same forces which caused the earthquake shocks in Mexico."

1907—(April 19) Earthquakes are reported for *this date*, from widely separated sections, *viz.*—a severe shock felt at 9:40 p. m. in the region surrounding Mostagalea, in Bulgaria; no mention is made of causalities or damage. A slight shock was felt at Charleston and Summerville, S. C., at 3:23 a. m.; three slight waving movements from north to west, lasting 8 seconds. Also a destructive shock experienced at Nueva Caceres, Southern Luzon; many buildings destroyed, but no loss of life reported. And from Manila, P. I., inter-

YEAR.	PLACE.	PERSONS KILLED.
	mittant shocks for over three hours in the morning; three of the shocks were severe. To complete the list for this date, the volcano Puyehue, now in activity, in the the province of Valdivia, Chile, developed several new craters.	
1907—(April 24)	The volcano Stromboli, in Sicily, became suddenly active, with a series of loud explosions; after throwing out a large quantity of incandescent stones, almost immediately afterwards, returned to its normal state.	

The foregoing extended tables of all the important, destructive earthquakes, that have occurred in the last 1900 years, have not been introduced here to satisfy idle curiosity, nor to awe the reader by the magnitude of the destruction of life; *but to show*, that the seismic phenomena is universal over the face of the earth, and least or *nil* where our predecessors placed the *Great Pyramid*. If we have made this point clear, we will now introduce another side issue, to assist us in the further elucidation of our theory, as to the extraordinary intelligence of the builders of that "first great wonder of the world," and of the impossibility of such a race of people to have existed at any period between 2,000 and 10,000 B. C.

(Sec. 7) USEFUL ELEMENTS OF ASTRONOMY, AND THE SOLAR SYSTEM.—THE SUN—☉—The solar system consists of a great luminous center, the sun, and the planets and comets which revolve around that body. The sun's diameter is computed to be about 850,000 miles. Its mean distance from the earth is about 92,000,000 miles. (Exactly 91,840,000 miles, as determined by Prof. Howard Vyse, in the measurement of the Great Pyramid Jeezeh.) The sun's volume is 1,400,000 times that of the earth. Its mass is said to be about 350,000 times that of our globe. The sun revolves upon its axis once in about 25 1-4 days. (Does the sun's heat reach the earth as is supposed? We say, no. *See article at the close of this chapter.*)

THE ECLIPTIC SYSTEM.

The ecliptic circle or earth's orbit, is divided into 12 equal parts or 30 degrees each. The zodiac is also divided into 12 equal parts of 30 degrees each; the zodiac is also divided into 12 parts called signs of the zodiac of 30 degrees each, and includes 9 degrees on each side of the ecliptic; these 12 signs of 30 degrees each constitute the 360 degrees of all celestial circles, and we may say at all distances from the center of the sun. The planets traverse around this circle in various periods of time, and each one at various distances from the sun, and at irregular motions. All planets move from west to east; longitude is reckoned from the first point in *Aries* in the same direction; celestial latitude, or declination, is reckoned from ecliptic north and south. The word "opposition" means when the earth comes between any of the superior planets (which have their orbits outside the earth's orbit) and the sun; and when these planets are on the opposite side of the sun to the earth, they are said to be in conjunction with the sun. When Mercury or Venus are in line between the sun and the earth, they are said to be in inferior conjunction with the sun; when they are on the opposite side of the sun to the earth, they are said to be in superior conjunction with the sun—their orbits are located inside the earth's orbit.

THE PLANETS.

The principal planets are Mercury, Venus, the Earth, Mars, Jupiter, Saturn, Uranus and Neptune, each member having its own peculiarities. Mercury possesses a rapid motion on an elongated orbit, that varies from the plane of the ecliptic more than seven degrees. Mercury passes through about as much ellipticity in the same length of time as all the other principal planets together, and moves over more than double the number of degrees of longitude in a day at about its perihelion, than what it does when about its aphelion—while Venus, the next planet to Mercury, moves upon an orbit nearer to a circle than any other planet in our system; therefore Venus is the most perfect planet among the solar members. The earth, the next planet to Venus from the sun, has from three to four times as much ellipticity in its orbit as Venus; it is also attended by a satellite of a large size for the magnitude of the earth. The earth is the first planet from the sun known to be attended by a moon. Mars is the next planet from the earth, and fourth from the sun; it is rather small for its location; its orbit is long, (and it possesses two tiny, and perhaps recently acquired, asteroid moons). There is a belt of very small planets, the Asteroids, located between the orbits of Mars and great Jupiter. Jupiter, the fifth and largest planet in the solar system, is attended by four satellites, and possessed, apparently, with bands about the body of the planet. Saturn, the sixth planet, has eight moons, and two great rings. Uranus, the seventh planet from the sun, possesses four satellites. Neptune, the eighth and last planet known from the sun, has one moon.

MERCURY—AN INFERIOR PLANET. ☿

Mercury's mean distance from the sun is 35,000,000 miles; its shortest distance is 28,000,000 miles; its greatest distance is 42,500,000 miles; its eccentricity is about 14,500,000 miles; its diameter 2,962 miles. Its time of axial rotation, 24 hours 5 minutes and 30 seconds; its mean orbital velocity is about 106,000 miles an hour. Its variation from the ecliptic is 7° 6′. Its orbital periodic time about the sun is; siderial, 87.96 days; synodical, 115.8 days. Mercury, Venus and our moon come in transit (apparently crossing the sun's disk), or in a direct line between the sun and earth, at periodic times. These bodies cannot withstand the undulating electric currents that they are subjected to in this position, therefore, they are, as it were, driven across the plane of the ecliptic at various angles, as though this electric force was a repulsion upon them or the matter composing them. This is the case with all bodies when placed in this position. The body of matter in the middle, or the body coming between two other bodies, absorbs the electricity from the two outside ones with great force, and by this force it expands and leaves this position by moving to one side or the other of the plane of the ecliptic, or rather crosses the plane at some angle that does not place it between two bodies so frequently. Mercury's rapid motion, its great density, and necessarily the remarkable change of this motion and density at about perihelion and aphelion passages, agitate the whole solar system upon many of these occasions. The great changes of motion, density, and electric currents account for the rugged, rough mountains, (supposed to be 50,000 feet high); also luminous points as seen upon Mercury's obscure disk—which are supposed to be volcanos in a state of activity, and which would seem to be a very reasonable suggestion of facts. (As the elements composing our moon must be in about some such a state of agitated changes, the bright illuminated points and lines upon the moon must be the illuminated gases escaping to the dark surface of the moon as they move from the illuminated to the dark side of the satellite.)

Venus—An Inferior Planet.— ♀

Venus, alternately the bright morning and evening star, moves on an orbit nearly circular, at about the mean distance from the sun of 66,000,000 miles. Its diameter is 7,500 miles. Its orbital velocity is about 77,000 miles an hour. It revolves on its axis in 23 hours and 21 minutes. Its siderial periodic time about the sun is 224.7 days; its synodical time is 583.9 days. Venus varies from the ecliptic 3° 23′.

The Earth. ⊕

Its mean distance from the sun is about 91,840,000 miles. Its orbital velocity is about 67,000 miles an hour. Its diameter, near 7,925 miles (7,924.9111). Its time of axial rotation, 23 hours 56 minutes and 4 seconds. It revolvs around the sun in 365 1-4 days.

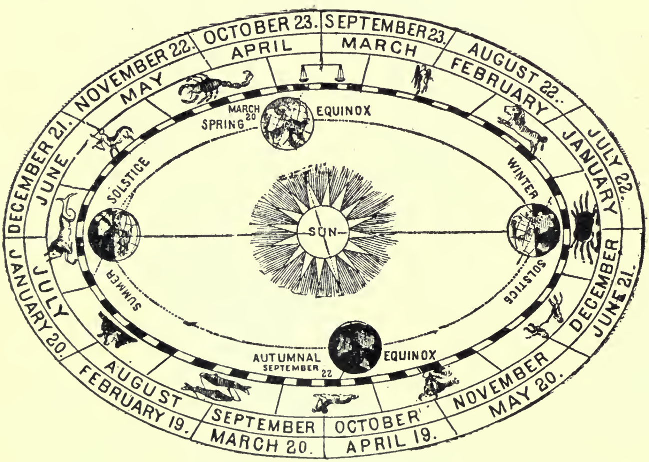
The axis of the earth is inclined 23 1-2 degrces from the perpendicular to its orbit. The axis of the earth is constantly (or nearly so) pointing to the north star. At the equinoxes one-half of the earth's surface is illuminated from pole to pole, hence the days and nights are of equal length. The earth passes its vernal equinox March 20th and its autumnal equinox September 22nd. By the 21st of June the earth's orbital motion brings the earth's position so that the sun is verticle 23 1-2 degrees north of its equinoctial point. This produces the summer solstice in the northern hemisphere, and winter in the southern hemisphere. The earth's orbital motion brings the earth's position so that the sun is verticle over its equator again September 22d, or at the autumnal equinox. The earth's orbital motion brings the sun vertical 23 1-2 degrees south of the earth's equinoctial point, on the 21st of December, or to the winter solstice in the northern hemisphere and summer in the southern hemisphere. The earth's orbital motion brings the earth's equinoctial point to the sun's vertical line and earth's equator again, March 20th, and by this illuminating one half of the earth's surface from pole to pole.

The extent of declination of the sun's verticle from the equinoctial is 23 1-2 degrees north or south, or on each side of the equator. At the summer solstice the sun is verticle 23 1-2 degrees north of the equator, and at the winter solstice it is verticle 23 1-2 degrees south of the earth's equator. This is called the obliquity of the ecliptic. These various (seasons or) periodic positions of certain parts of the earth's surface are brought to the sun's verticle by a sort of a spiral motion of the earth on its orbit—which orbital motion brings these certian parts of the earth's surface under the sun's verticle at these certain seasons of the (year or by the) earth's annual revolution about the sun, as described above—or at spring, summer, autumn and winter seasons and positions.

The earth is in perihelion about December 31st, and in aphelion about the 1st of July. Its perihelion is in longitude 100° 21′, and its aphelion is 280° 21′. The earth's volume, according to Airy, is only one part out of 1,400,000 volumes of that of the sun. Its mass is one part out of about 352,000 parts of the sun.

THE CHANGES OF THE SEASONS.

The following cut exhibits the earth in its various positions as it moves, in its orbital motion, through the season constellations—its spring equinox, its summer solstice, its autumnal equinox, and its winter solstice, etc.



The equinoxes move westward about 50″ annually. The earth's perihelion point moves eastward about 12″ a year. By this movement of the vernal equinox westward 50″, and the perihelion eastward 12″, these two points become further apart each year (for a long time) by 62″, or 1′ 2″. A revolution of 360 degrees, (of procession, or falling back of the equinoxes) would require about 26,000 years—while the advance of the perihelion, or apside, eastward through 360 degrees, or a revolution, would require about 110,000 years.

THE MOON—OUR EARTH'S SATELLITE. ☾

The moon is our nearest planetary neighbor. It is a body of matter revolving about our globe, and apparently exercising considerable influence upon our sphere. The moon's mean distance from the earth is 238,800 miles. Its least distance is 225,700 miles, and the greatest distance is 251,900 miles. It is 26,000 miles nearer the earth at perigee than it is at apogee. It revolves on its axis to the sun, in 27 days 7 hours and 43 minutes, which is about the same period of time as that of its sideral revolution. Its synodical period is 29 1-2 days. It possesses no axial rotation to the earth, therefore it always turns about the same side towards our globe. It appears to move around the earth at about the rate of 2,273 miles an hour. Its variation, or the inclination of its orbit to the plane of the ecliptic, is 5° 8′. The moon's orbit revolves around the earth, as well as the moon itself—that is, its nearest and farthest orbital points make a revolution around the earth once in each 8 years and 310 1-2 days. This is termed the progression of the apsides. The line of the moon's nodes is also in motion, moving around the earth and ecliptic in a retrograde direction, or from east to west, in a period of about 18 1-2 years. The moon's nodes are the two points where the moon touches or crosses the plane of the ecliptic or earth's orbit, on its passages going from north to south, or from south to north declinations, etc.

MARS—A SUPERIOR PLANET. ♂

Mars is the fourth planet from the sun. It is a small body, with a long orbit. Its mean distance is 152,000,000 miles; its least or perihelion distance is 126,300,000 miles. Its diameter is 4,920 miles. It revolves around the sun in 686.97 days. Its axial rotation takes 24 hours 37 minutes and 23 seconds. Its variation from the plane of the ecliptic is 1° and about 51′. Mars is about 26,000,000 miles nearer the sun at perihelion than at its aphelion. Mars has two small satellites. They were discovered at Washington, D. C., in 1877, by Prof. A. Hall. The inner moon is about 4,000 miles from the planet; its orbital revolution is 7 hours and 39 minutes. The outer one revolves about the planet in 30 hours and 17 minutes.

Mars is an oblate planet—according to William Herschel, its equatorial diameter is 272 miles greater than its polar diameter; but Mr. G. R. Hind makes its equatorial diameter 85 miles greater than its polar diameter. But Mars possesses 26,000,000 miles of elipticity in its orbit, and the length of a planet's orbit governs the axial rotation of the planet, and the axial rotation controls the quantity of the ellipticity in a planetary path, and the length of the ellipticity in an orbit must regulate the shape of the planet's body or matter, itself—or the ellipiticity in a planetary orbit regulates the amount of change that it goes through each orbital revolution; and those with the longest orbits go through the greatest amount of change, each orbital revolution. A mass of matter having no axial rotation to the body that it revolves about is a perfect comet to that central body. A planet or body of matter, having a perfect axial rotation possesses no ellipticity in its orbit, therefore goes through none, or but little change of density or motion in its orbital revolutions. Venus is nearly in this condition. Mars possesses 26,000,000, and the earth 3,000,000 miles of ellipticity, in their orbits—therefore Mars contains 8 2-3 times as much ellipticity, in its orbit, as the earth—consequently, in the same proportion, if Mars has (in round numbers) 160 miles of oblateness in its conformation, the earth should have 20 miles, or $160 \div 8 = 20$ miles; this making the earth's equatorial diameter 20 miles greater than its polar diameter. Prof. Richard Mansill's theory is, "that the remarkable illumination and brightness about Mars, and its bright spots, are caused by and through the illuminated gases that are about the planet, and needed to enable the body to go through the great amount of change of motion and density that it must pass through, to adjust itself to the great quantity of ellipticity that is in its orbit." This planet possesses about 20 per cent.

of the element, or nature of a comet, in its ellipticity. This is possibly the cause of this planet appearing to vary so much, at times, as it is said to do.

THE ASTEROIDS, OR PLANETOIDS, MINOR PLANETS.

This belt of numerous small planets is located in the space between Mars and Jupiter. Their orbits are included in a wide ring at an average distance of about 255,000,000 miles from the sun. Their orbits incline at various angles to the ecliptic, and their paths possess considerable eccentricity. These bodies are so small that little is known about the elements composing them.

JUPITER, A SUPERIOR PLANET. ♃

Jupiter is the fifth principal planet from the sun; it is the largest of the planets. Its equatorial diameter is about 88,000 miles. Its mean distance from the sun is about 475,600,000 miles; its least, 452,000,000, and its greatest, 498,000,000 miles from that body. The time of axial rotation is supposed to be 9 hours and 55 minutes. Its orbital motion is 28,700 miles an hour. Its orbital periodic time is 4,332.58 days. Jupiter's equatorial diameter is supposed to be about 5,000 miles more than its polar diameter. Jupiter is about 45,000,000 miles nearer the sun at its perihelion than at its aphelion passages. The volume of Jupiter is about 1,244 times that of the earth. The inclination of Jupiter's axis to its orbit is about 3 degrees. The inclination of its orbit to the plane of the ecliptic is 1° 18′. Its synodic period is 398.8 days. (Its mass is said to be about 301 times that of the earth.) Jupiter has four moons, at the following distances from the planet: 264,000; 423,000; 678,000; and 1,118,000 miles.

SATURN, A SUPERIOR PLANET. ♄

Saturn, the sixth principal planet from the sun, revolves around that body in 10,759.22 days, or about 29 1-2 years, at a mean distance of 872,000,000 miles. (Its synodic period is 378 days.) Its least distance is 823,000,000 miles, and its greatest distance is 921,000,000 miles. Saturn is supposed to revolve on its axis once in 10 hours and 29 minutes. Its equatorial diameter is 77,900 miles. Its oblateness is greater than any other planet. The planet's polar diameter is considered to be 7,800 miles shorter than its equatorial diameter. The inclination of its orbit to the plane of the ecliptic is about 2 1-2 degrees. Saturn is about 98,000,000 miles nearer the sun at perihelion than at aphelion. Its velocity in its orbit is about 21,221 miles an hour. The inclination of its axis to the plane of its orbit is about 27 degrees. This planet is encompassed by three rings, and accompanied by eight satellites. (The astronomers at large are as much at sea over the rings of Saturn, as the architects are over the building of the Great Pyramid.)

Uranus, A Superior Planet. ♅

Uranus is the seventh principal planet from the sun, and revolves around that body at a mean distance of 1,753,000,000 miles, in a period of 30,686.82 days, or about 84 years. Its least distance is 1,672,000,000 miles, and greatest distance is 1,835,000,000 miles. Uranus is about 163,000,000 miles nearer the sun at perihelion than at aphelion. The inclination of its orbit is 46 1-2 minutes. Its synodic period is 369.65 days. Uranus' diameter is 33,000 miles. Its equatorial diameter, like Jupiter and Saturn, is greater than its polar diameter, but the difference is not exactly known. The volume of Uranus is about 72 1-2 times that that of the earth. Uranus is attended by four moons, that revolve about the planet in the opposite direction to that of the motions of other satellites about their primaries. Its velocity in its orbit is 14,963 miles an hour.

Neptune, A Superior Planet. ♆

Neptune is the eighth principal planet from the sun, around which body it revolves in 60,126 days, or about 164 1-4 years, at a mean distance of 2,746,000,000 miles. Its least distance is 2,722,000,000 miles, and greatest distance is 2,770,000,000 miles. Neptune is about 48,000,000 miles nearer the sun at its perihelion passage than it is at its aphelion passage. The inclination of its orbit to the plane of the ecliptic is about 1 3-4 degrees. Its diameter is 36,600 miles. Its synodic period is about 367 1-2 days. Neptune is attended by one satellite that revolves around the planet in a retrograde motion, or from east to west like the moons of Uranus.

ECCENTRICITIES OF THE PLANETS.

The eccentricities of the planets, as considered by one-half their major axis, are approximately: Mercury, 1–5; Venus, 1–145; Earth, 1–60; Mars, 1–10; Jupiter, 1–21; Saturn, 1–18; Uranus, 1–22; Neptune, 1–111.

THE EARTH AND WORLD BUILDING.

(Sec. 8.) The above subject should have preceded this work in a full quarto volume; (as we stated in our preface) but a short chapter introduced at this point of our discussion, on the above subject, will relieve us of further explanation when we come to the subject of the material used in the building of the *Great Pyramid.*

THE CREATION AND THE CREATOR.—In reference to the creation and the Creator, we are led to suppose that an all-wise and an all-powerful and an almighty Omnipotent or Being, who might govern all the matter of this universe with his wisdom and will, but whom, we think, would start the universal elements in their motions, changes and combining conditions in such a manner as he intended them to go in, in the start. Such a system as this appeals to us, but we can hardly think that he would be patching and mending the job or any personal parts of it on its way as it moved along. There are no known exceptions allowed to any reasoning individuals by way of emollients exempting them from the vital natural laws and forces, as they all must eat (to live), drink, sleep and grow (and decay), just like and as the wild brute or animal creation has to do. Therefore, if reasoning persons seek pleasure to an extent of violating natural laws and their requirements, the human flesh or substance suffers for it to an equal extent of the violation of such laws committed. Therefore, there is no need of a Supreme or an All-Wise Being interfering with the petty affairs of human beings. This theory may appear to indicate to some extent that (cultivated mind) reasoning human individuals, as being somewhat as free agents, but who at the same time (we think) must pay the penalties of their own follies and crimes with the pangs and pains in their own living flesh.

The whole system is a grand one, and we are simply trying to learn what elements our mass (the earth) is composed of, and about when and how it commenced to grow or condense, and at about what stage or age animal and vegetable life commenced upon our globe, and what is likely to be the final results of the earth. As the masses are not ready for such a solution (or theory), our reward will be, simply the love we have for this beautiful scheme.

Appearance of the First Germs of Life Upon the Earth.

No life could have existed upon the earth until the primary or crystalized rock formation had condensed and become solid enough and sufficiently steady and quiet long enough to support animal life. And, life even then, and that of the lowest kind, could not have commenced upon the globe until dry land had appeared, and the carbon existed in a state of solution, and this being washed about the silicated shores where this element (carbon) could expand and unite with the oxygen of the air.

At or about this time the first life on this globe could have commenced, or as soon as a single organic cell could be formed, and this would occur coinciding with the first formation of carbonic acid gas, and which would generate at the same time a little alcohol and spirits, and as the carbon expanded upon the shore it is probable that a portion of the atmosphere would be absorbed and condensed—they would constitute the the organization of the organic elements, or such as the hydrogen and oxygen composing the water—the carbon in solution and the nitrogen of the atmosphere, and until these conditions existed no life could have taken place on this globe. But as soon as these conditions did exist, nothing could prevent these elements from going into animal and vegetable life; (the lower orders) of life spread rapidly all over the dry part of the earth. Nothing up to this day has or could prevent animal growth or decay, nor is anything likely to put a stop to its progress for a long time in the future. Two-thirds of the (dry) earth is covered by a scum of life that cannot be suppressed as long as there is carbon in water in solution and nitrogen gas in the air, but as it is at this time and as it has been since the first dawn of life upon our sphere. Those who contend that the spontaneous generation of low orders of animals are going on today are probably correct; and those who contend that life started from a secret or unexplainable germ and that life is the continuation of a germ that no one knows anything about, may hold their own for a time, for the reason that natural life cannot germinate or develop without a free access of moisture, or water and atmosphere and carbon and nitrogen. They are all contained in the germs of life when compounded in suitable (solutions and) quantities, but when put under an influence that produces death or something that prevents chemical action, then, of course, there is no development of life. But when the organic elements, as referred to above, are left free to mingle, then life is the result, and it cannot be repressed from developing and making itself manifest in the shape of the lower orders or forms of life. The first organic matter collected on the earth would likely be a corruption of organic elements—water and carbon in solution, and other earthy and slimy matter and the atmosphere. From such a mass fermentation and decomposition would be inaugurated. from which a little hydrogen would escape, and where carbonic acid would be developed by the expanding carbon and condensing oxygen, and they united, and at the same time a portion of nitrogen may be absorbed and condensed—and here would be the germ or development of the cell. The carbonic acid would hang about the land or shore, uniting with other matter, and under the sun's influence would commence to develop a low order of vegetable matter or such matter as the naturalists have been unable to decide whether it belongs to the animal or vegetable kingdoms. We now reach the lichens, mosses, fungus, algæ or sea-weeds and other low orders, of a near compound of animal and vegetable matter—from the decomposition of this class of infusoria, animalculæ, monads, etc., would appear. The fermentation of this matter would develop carbonic acid to feed and support the growing of vegetation. The decaying vegetation would furnish the juices about the shores to support fermentation and the low orders of animal life about the shores which would result therefrom. Therefore, after life had reached this stage of progress, the advance would likely be very rapid, both in quantity and quality of animal and vegetable types.

THE AGE OF THE EARTH.

If we assume that it requires a year to grow vegetation enough to form one ton of merchantable coal to the acre when converted into that element, and there are about an average of 1,000 tons of coal to the acre in a vein one foot thick or 4,000 tons in a bed four feet thick, and 8,000 in an eight foot stratum—or say it would require 100,000 years at this rate to supply 100 feet of combined coal beds, or at the same rate of building the earth's crust up by chemical condensations it would need or require 1,000,000 years for each 1,000 feet, or 100,000,000 years for each 100,000 feet of the earth's crust. Therefore, it has been perhaps possible to build up parts of the earth's crust at about the rate of one foot in 1,000 years—but, as there were always parts of the earth covered by water, nothing like this much (under the water) could be accomplished. Therefore, this time may be multiplied by five, or say it would take 500,000,000 years to build up the first 100,000 feet of the earth's crust— or about this same proportion of time, let it (the thickness) be more or less, to produce the same amount of the earth's crust or strata. As it is possible that this contains most of the earth's crust (and perhaps more), as the temperature increases one degree for every 60 feet of descent, and as this would fuse everything known to us before reaching 100,000 feet from the earth's surface, there is no doubt but the earth has been principally built up by chemical condensations, even from the first condensations (of oxygen and hydrogen) of the primary crystalline rocks, when oxygen and silicium, oxygen and aluminium, oxygen and magnesium, and afterwards oxygen and calcium, were condensed together (also oxygen and carbon). This is the manner and way in which the crust of the earth has been condensed and built up to its present condition—and not by the spontaneous radiation of heat (from it) so-called, and which is generally supposed to have been the case or cause of the cooling and condensing and building up of the earth's crust. All the primary rocks were formed and condensed in regular order by chemical combinations. The primary crystalline rock formation went on, followed by the Silurian measures; then the Carbon age appeared with its fermentations, and by this furnishing food and substance for vegetable growth, and this vegetation became food again for animal live of both marine and land species. We quote the following from "*A New System of Universal Natural Science*," by Mansill: "Therefore, to sum the progress of our globe up to this time, in short it is this: The earth's crust is constantly being worked over and over again by internal and external corrosians, and by this it is made thicker and harder through the absorption of oxygen from the air and space to supply the chemical processes that are performed through the long progress of the construction of the earth's crust.

The consumption of oxygen from the air for each individual amounts to about two pounds a day, and for every 6 pounds of pure carbon consumed in combustion, the world over, consumes 16 pounds of oxygen to convert it into carbonic acid gas, much of which gas is absorbed by the waters of the globe, and therein forming chemical compounds with the earthy elements within the water and thereby building up the strata of the earth. All the processes of fermentation and decompositions absorb oxygen from the atmosphere in this manner to support their operations. Therefore the total consumption of oxygen extracted from the air each day to support the chemical actions cannot be much less than from 10,000,000 to 20,000,000 tons per day. For every 8℔s of hydrogen gas burnt there must 64℔s of oxygen condense and contract its volume to form 72℔s. of water. Just think of the quantity of oxygen and hydrogen stored in all the waters of the globe! If this fluid averaged 2 1-4 miles thick all over the globe we should have two miles deep of a belt of oxygen and one-fourth of a mile thick of hydrogen—that is, if these two elements were separated into their component parts.

We therefore, find our earth, at this time, existing as a globe of matter composed (chemically speaking) of several kinds and various densities, and possessing a diameter of about 8,000 miles and a circumference of about 25,000 miles and an area of about 200,000,000 miles, and moving through space at the rate of about 66,000 miles an hour, and at a supposed distance from the sun of 92,000,000 (pyramidal measure 91,840,000) miles. The contents of its volume is computed to be about 260,000,000,000 cubic miles. The number of tons of matter it contains is computed to be about 3,510,000,000,000,000,000,000 tons (this is computing the earth as being solid and three times the weight of water). Therefore, if the earth was composed totally of oxygen it could have absorbed and condensed about 11,000,000 tons of oxygen a day, or about four billion tons a year for a period of 875,000,000,000 years in order to reach its present condition. But allowing half of this time for the first accumulation of matter—as a mass of gas—in the shape of a globe or comet, and then take one-half of the other half for the other matter contained in the composition of the earth, then there could have been condensed by the earth 11,000,000 tons of oxygen each day for more than 200 billions of years in bringing the earth to its present condition, and even if our earth consisted of only a shell of dense matter not exceeding one hundred miles in thickness it could have consumed 11,000,000 tons of oxygen a day for many millions of years. Therefore, such is the supply of nature's resources."

ROCKS AND STRATA AND THEIR COMPOSITION.

GRANITE.—It has been considered that granite was the foundation and oldest rock of the earth's crust. It may be the oldest compounded consolidated rock, but it can hardly be the oldest rock making substone, for it is composed of quartz, mica and felspar.

QUARTZ.—Composed principally of silica and silex is composed of 51 parts of oxygen and 49 parts of the base. Felspar is composed of 67 parts of silica, 18 of alumina, 2 of lime, 12 of potass and one part of the oixde of iron. Mica is composed of 47 parts of silica, 22 of alumina, 14 of potass, 15 of the oxide of iron and 2 parts of the oxide of manganese. Therefore, when we reach the structure and composition of granite in the building up of the earth's crust, we have silicium and oxygen united, forming silica; and this united with alumina, potass, oxide of iron, a little lime and a small quantity of oxide of manganese; consequently the earth must have been a long way advanced in the progress of condensing and constructing its crust when granite was compounded.

THE ELEMENTS CONDENSED TOWARDS FORMING THE EARTH'S CRUST.—The first elements to condense in forming the earth's solid crust would appear to be silicium, which appears to have the strongest absorbing or uniting power for oxygen (excepting, perhaps, hydrogen —which probably had the strongest absorbing power for oxygen, and claimed it to form the waters and vapors about the globe)—and by this forming silex and silica. Potassium would likely be the next element claiming oxygen with the strongest force to condense with; and iron the next in force and in order as uniting with the oxygen, and these elements would probably unite with the alumina, together with a little lime and manganese. In this mass of condensed matter from the metallic and earthy vapors and gases are the elements to constitute the rock termed granite. Silicium is an earth, potassium, aluminium and iron are metals. These, the apparent first condensed elements in the earth's crust, compose quartz, felspar and mica in their various component parts, and these united in their proper constituent proportions (as they are) constitute granite.

CLOSE APPROXIMATION OF THE COMPOSITION OF VARIOUS ROCKS.

	Quartz	Felspar	Mica	Talc	Chlorite	Slate	Horn-blende
Silica	98	67	47	62	50	49	42
Alumina	2	18	22	2	26	24	12
Magnesia	0	0	0	27	0	2	3
Zinc	0	2	0	0	2	0	11
Potass	0	12	14	0	17	5	0
Oxide of Iron	0	1	15	3	5	11	30
Oxide of Mangnese	0	0	2	0	0	1	1
Carbon	0	0	0	0	0	1	0
Water	0	0	0	6	0	7	1
	100	100	100	100	100	100	100

For the composition of the different varieties of granite, also limestone, marble, etc., see index, for a complete list of all "mineral substances," in another part of this work.

THE FIRST ROCK.—From these compounds or combinations—silex, silica, sand, sandstone—pure silica sandstone would appear to be the first rock formation condensed in the earth's crust. This would seem to be the case from the strong power that silicium has to unite with oxygen, and it being found so abundant in the earth's crust from first to last.

THE FIRST CONDENSED CARBON.—The very first carbon that condensed on the earth into a solid must have contracted its volume mechanically, for it could not have condensed chemically into the diamond or graphite, as these elements are not compounds, therefore it could not even unite with oxygen (to form carbonic acid), for when carbon does unite with oxygen to form carbonic acid gas, the carbon expands its volume to unite with it about as much as the oxygen contracts in volume—and when it unites with oxygen to help to form a solid, it does so indirectly, as it does in the case of forming carbonate of lime, it first absorbs oxygen enough to enable it to expand into carbonic acid gas—it then becomes absorbed (itself) by the water—water having a very forcible absorbing power for carbonic acid—water takes up about an equal volume of this gas. The mechanical process of forming the diamond (condensed pure carbon) by the action of the earth, could have been accomplished during any great upheaval, or sudden changing of the earth's polarity.

LIME.—The metallic base of lime is calcium, combined with oxygen like the other earths. Most limestone contains 57 per cent. of lime and 43 of carbonic acid. When burned in kilns the moisture and much carbonic acid is driven off, but the caustic lime soon absorbs moisture and carbonic acid from the air again.

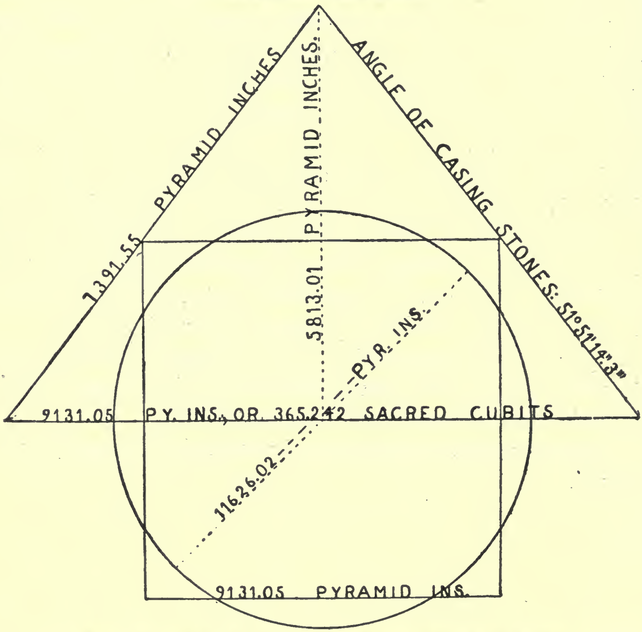
HYDROGEN AND OXYGEN.—It is, perhaps, harder to tell or learn when hydrogen was first condensed (with oxygen into water) than it is with any of the other elements there were probably watery vapors mingled in the mass of expanded gases that composed the earth the day that it assumed its axial rotation and became a planet. Pure hydrogen gas appears to be more naturally united with oxygen gas in process of explosions than in any other way, and by this forming water—one pound of hydrogen gas (which is two volumes) unites with eight pounds of oxygen gas (which is one volume) to form nine pounds of water, or the hydrogen as a gas is 194 1-2 feet, and the oxygen as a gas is 96 1-2 feet, the water after the collapse is about one-sixth of a foot and can produce a motion through space of 20,000 miles an hour, while the hydrogen could only support a motion of 1 2-3 miles an hour and the oxygen produce a motion of 26 1-3 miles an hour—such are the conditions wrought among elements by chemical combinations.

[A more complete epitome of the planets, and the new theory regarding the (supposed) heat of the sun, will be found in the later chapters of this work.]

We have now to deal directly with the Great Pyramid Jeezeh.

MEASURE OF THE CIRCLE.

The Circle Squared.



[Great Pyramid's square base, and circle with radius=Pyramid's Vertical height.]

The above diagram shows, approximately, the proportions of the "Great Pyramid Jeezeh," of Egypt. NOTE.—The Pyramid inch=1.001 inch English, and the sacred cubit=25 Pyr. ins.

First—We will present the closest approximation to the above assertion, in medieval and modern times, through the key of what is termed *pure mathematics*. Mathematicians and philosophers have asserted that the nearest approximation possible to the—π, or the value of the circumference of a circle in terms of its diameter,=**3. 14159265358979323846264338327950288419716939937510582097494459230711640628620899862803482534211706798214808651328230664709384460955058223172535940812848 02+**, &c., &c., &c.

Second—The next nearest approximation is of *applied mathematics*, or of astronomical and physical science, as furnished by all the first-class nations of the world, who have been working publicly for centuries, and at a cost of millions of money, and have attained, or are on the point of attaining, an accuracy, sometimes only in the second figure, sometimes in the third, fourth, fifth, or even lower figures, according to the greater or less difficulty in the nature of the question concerned. As thus:—Polar diameter of the earth =between 500,378,000 and 500,560,000 English inches.

Mean equatorial diameter of the earth bet. 502,080,000 and 502,230,000 Eng. ins.

Mean density of the earth bet. 5.3 and 6.5; the two latest determinations by powerful government institutions.

Mean distance of the earth from the sun bet. 91 and 93 millions of miles, Eng.

Obliquity of the elliptic in 1877 A. D.=23° 27′ 17″.9 to 23° 27′ 19″.0.

Length of the solar tropical year in mean solar days=365.24222 to 365.24224.

Precession of Equinoxes in years=25,816 to 25,870.

Third—To claim to have found anything that is *new*, or revive a *problem* that is *lost* in the mist of antiquity, requires a courage in this day of enlightenment and understanding—to be willing to stand alone to act, to think, to do

THE GREAT PYRAMID OF JEEZEH.

Situated in the centre, and at the same time at the border, of the sector-shaped land of Lower Egypt, in the **Geographical Centre** of the land surface of the whole world, and about 9 miles S. of W. of Cairo, the present capitol of Egypt, on the west bank of the Nile, in 29° 58′ 51″ N. Lat. and 31° 10′ 1″ E. Lon. is the Great Pyramid of Jeezeh, in Egypt.

Egyptologists referred to for the following notes on the Pyramids of Egypt, are: Piazzi Smyth; Howard Vyse; Wm. Osborn; Dr. Lepsius; Lane; Wilkinson; Rawlinson, &c.

The Name of the Great Pyramid. Varieties of orthography by different authors, which may lead to the correct pronunciation, are as follows: Djiza, Dschiseh, Dsjise, Dzireth, El-Geezeh, Geezeh, Gheezeh, Ghizeh, Gizeh, Gyzeh, Jeezeh, Jizeh, &c.

Dr. J. A. S. Grant, writes from his Sanatorium, Palais Mantatia, in Cairo, in March, 1877, that Jeezeh, or Geezeh, is the proper way of spelling this word in English.

Names of the Builders of the Three Largest Pyramids of Jeezeh, According to Various Authorities.

AUTHORITIES.	Builder of the Great Pyramid.	Builder of the Second Pyramid.	Builder of the Third Pyramid.
Herodotus...........	Cheops.	Chephren.	Mycerinus.
Manetho.............	Suphis I.	Suphis II.	Mencheres.
Eratosthenes........	Saophis. Comastes, or Chemati stes.	Saophis II.	Mescheres Heliodotus.
Diodorus Siculus...	Chembres.	Cephren.	Mycerinus.
Modern Egyptologists...	Shofo. Shufu. Koufou.	Nou-Shofo. Noum-Shufu. Shafre.	Menkere. Menkerre. Men-kaw-ra.

Date of the building of the Great Pyramid.

The most satisfactory estimate, of any Egyptologist who has attempted to fix the date of the building of this "**First Great Wonder of the World,**" is by Piazzi Smyth; who has by a series of actual measurements and observations, mathematical, astronomical and geographical, extending over some fifteen years, fixed the date about **2,170 B. C.** (Other authorities, without naming them, place the date varying from 150,000 to 1,950 B. C.) Any one who will closely examine all that has been written upon this subject, during the present century, will come to the remarkable conclusion—that, it was either built thousands of years prior to the assumed date of man's existence on the earth, by a race vastly wiser; or, that it was designed by the "Great Architect," who rules all things.

Prof. H. L. Smith, of Hobart College, Geneva, N. Y. (in a private letter) speaking of the Queen's Chamber, in the Great Pyramid, remarks, "Either there is proof in that chamber of supernatural inspiration granted to the architect;" or— "That primeval official possessed, without inspiration, in an age of absolute scientific ignorance 4,000 years ago, scientific knowledge equal to, if not surpassing, that of the present highly developed state of science in the modern world."

Position, Size, Area, Height, etc., of the Great Pyramid.

The Great Pyramid is built upon, and near the edge of an elevated rocky steppe, about 130 feet above the fertile plains of the Nile, and about 125 feet above the neighboring alluvial plains as now covered with sand, upon a solid ledge of limestone and porphyry, the strata of which lay horizontal. The structure at its base is supposed to be a perfect square, and its height, the proportion of the square of such base, as the value of the circumference of a circle is to the diameter of the same, thus: Diameter **1.** Circumference is=**3.** 141592653589793238462643383279502884197169399375105820974944592307816406286208998628034825342117067982148086513282306647093844609550582231725359408128 4802+.

With this exception, the belief exists, that the circle has **actually** been squared by the Pyramid measurements, if we can correctly measure them to their ancient positions. This Pyramid faces **exactly** North, South, East and West, and the **only** one that does, of all the Pyramids in Egypt.

For the equivalents of the "Pyramid Inch," and "Sacred Cubit," used in the calculations which follow—see table of Pyramid Weights and Measures below. It will be observed that in nearly every weight or measurement in the construction of this Pyramid, the figure 5 is conspicuously present.

Pyramid Weights and Measures.

The basis by which the following results were obtained, are viz: **For Lineal or Surface Measure**, the one 500-millionth of the Earth's Axis of Rotation, which is=1 Pyramid Inch, and equivalent to 1.001 Inch English. **Weight Measure**, is based on the Earth's Size and Density. **Capacity and Dry Measure**, on the Cubic Contents of the Coffer in the King's Chamber. **Heat and Pressure, Angle and Time**, on Cosmical, Geographical and Pyramidal measures.

The Standard of Length employed in laying out the Great Pyramid, viz: The Sacred Cubit=25 Pyramid Inches, in the measurement of the perimeter of the building, found to represent a theoretical circle, brings out the true length of a solar year, viz: 365.242 days.

Measures of Length.

NAME.	Length.	Eng. Equivalent.	Basis.
Pyramid Inch..........	1.	1.001 Inches	=1-500-Millionth, Earth's Axis Rotation.
Pyramid Sacred Cubit.	25.	25.025 Inches	=1-20-Millionth, Earth's Axis Rotation.

Weights and Measures.

Division, or number, of each part contained in weight standard.	Intermediate divisions.	Weight of the part so divided in Pyramid lbs.	Capacity of the parts in Pyramid cubical inches of Earth's Mean Density.	Capacity of the parts in Pyramid cubical inches of distilled water. (T. 50° B. 30. of Pyramid.)	Name now proposed to be given to each kind of part.
1	0	2,500.	12,500.	71,250.	Ton.
4	4.	625.	3,125.	17,815.	Quarter.
10	2.5	250.	1,250.	7,125.	Wey.
25	2.5	100.	500.	2,850.	Cwt.
250	10.	10.	50.	285.	Stone.
2,500	10.	1.	5.	28.5	Pound.
25,000	10.	0.1	0.5	2.85	Ounce.
250,000	10.	0.01	0.05	0.285	Dram.
25,000,000	10.	0.0001	0.0005	0.00285	Grain.

Capacity Measure.

1 Coffer=4 Quarters=10 Sacks=25 Bushels=250 Gallons, and is=71,250 cubic ins., the capacity of the Coffer in the King's Chambers. **Fluid Measure**—28.5 Pyramid cubic inches=1. Pyramid pound=1. pint, &c.

Thermometers in different countries, compared by placing the 0° at freezing in each, you have the same absolute temperatures in terms of five different thermometric scales.

Fahrenheit.	Modified Fahrenheit.	Centigrade.	Réaumur.	* Pyramid.
122°	90°	50°	40°	125°
104°	72°	40°	32°	100°

* The Pyramid Thermometer consists of 250° between the boiling and freezing point; one-fifth above the freezing point, or 50° the average temperature of all lands, and=the Mean temperature at the level of the King's Chamber in the Great Pyramid; which is situated on the 50th layer of stone from the pavement of the same; and upon the 5th layer of stone that is 30 inches in thickness. The former corresponding to the Mean temperature, viz: 50°; the latter to the barometric pressure of 30 inches at the level of the sea.

PYRAMID FEATURE.	SYSTEM OF ANGLE MEASURES.			
	Babylonian.	French.	Vulgar.	Pyramid.
A whole circumferance.........	360°	400°	32°	1,000°
Angle of side with horizon......	50° 51′ 14″	57°.62	4°.61	144°.05
Angle of passages..............	26° 18′ 10″	29°.23	2°.34	73°.08

The casing stones of the Great Pyramid have an external slope of 51° 51′ 14″ .3 as affected by its horizontal masonry courses. For every **ten** units which its structure advances inward on the diagonal of the base to central, nocturnal darkness (of the Great Pyramid), it practically rises upwards, or points to sunshine, daylight and sky, by **nine.** It is claimed by Mr. Wm. Petrie, C. E., that the radius of the earth's mean orbit round the sun, however far away that may be, is in this same proportion of 10:9. By this measurement the sun is estimated to be about 91,500,000 miles distant from the earth.

Number of sides of the whole building, 1 square, and 4 triangular..............=5
Number of corners—4 on the ground and 1 anciently aloft......................=5

	Pyramid Inches.	Sacred Cubits.
Ancient and present base-side **socket** length............	9,131.05	= 365.242
Ancient and present base-**diagonal** socket length........	12,913.26	= 516.5304
Present dilapidated base-side length, about................	8,950.	= 358.*
Sum of the two base-diagonals, to the nearest inch.........	25,827.	=1033.08
Area of the base in square Pyr. inches, 3,376,074.1025=5,401.718564 Sacred Cubits=13.292 Pyramid Acres.		
Ancient area of the square pavement, about 16. Pyr. Acres.		
Ancient vertical height of apex completed, above pavem't	5,813.01	= 232.5204
Present dilapidated height, vertical, about................	5,450.	= 218.
Ancient inclined height at middle of sides, from pavement to completed apex..................................	7,391.55	= 295.662
Ancient inclined height at the corners, pavement to apex..	8,687.87	= 347.5148
Ancient vertical height of apex above the lowest subterranear chamber..	7,015.	= 280.6
Elevation of pavement base, above the average water level.	1,750.	= 70.
Elevation of pavement base, above the Mediterranean Sea..	2,580.	= 103.2
Elevation of the lowest subterranean excavated chamber above the average water level of the country...........	250.	= 10.
Length of side of present platform on top of Great Pyramid (it is flat, except in so far as it has four or five large stones upon it, the remains of a once higher course of masonry), roughly..................................	400.	= 16.

Measurement and Quality of Material.

The pavement in front, and around the base of the Great Pyramid is formed of stones 21 inches thick by 402 inches in breadth, their length is not known (as they extend under the Pyramid). A chasm or crack in both pavement and rock beneath, near the North front, extends to the depth of about 570 inches. The whole building from very base to apex is not solid masonry; but as clearly shown by the N. East basal corner, and indicated more or less at a point or two in the wall, and the descending entrance passage, includes some portions of the live-rock of the hill. Such portion having been, however, trimmed rectangularly, and made to conform in height and level with the nearest true masonry course. The supposed complete mumber of masonry courses, including the original topmost cornerstone is 211; of which 202 are still in place, and a portion of 2 in fragment; and 7 courses are wanting entirely. These courses of squared and cemented blocks of stone in horizontal sheets, one above the other, form the mass of the building of the Great Pyramid; they vary in height from 19 to 79 inches, the first course being the thickest, (viz: 79 inches roughly; and the courses are laid without any regard as to thickness; to illustrate: the first five courses (in rotation) are 79, 56, 48 40 and 40 inches in thickness, the 35th to the 39th courses run 24, 50, 41, 39 and 38; while the last five courses, that are still in position, are 22 each in thickness. **Material used.** The casing-stone material—compact white lime-stone from the Mokattam Mountain quarries on the east side of the Nile, with a density =0.367 (earth's Mean density=1). General structure material of all the ruder part of the masonry—nummulitic lime-stone of the Pyramid's own hill, with a density=0.412. The inside finishing stone of the King's and Queen's Chambers, the Coffer, the main entrance and the grand gallery, are numerous, the principal of which are Red Granite, Black Granite, Gray Granite, Black Marble, Thebaic Marble, Porphyry and Lime-stone; the granite of which, is supposed to have been brought from the quarries of Syene, 550 miles up the Nile, as there is none nearer, on the river.

Principal Measurements within the Great Pyramid.

Entrance to Pyramid. This is, at present, only a hole, or doorway, or upper end of a hollow passage-way, inclining thence downwards and inwards. It is situated on the Northern flank of the Pyramid, in a very broken part of the masonry now, at a height above the ground, rudely and imperfectly considered, about=**588** Pyr. ins. Distance of the centre of that doorway—hole Eastward of center of the Pyramid's Northern flank, as between its E. and W. ends=**294** ins.; height of said doorway, transversely to length of passage way=**47.24** ins.;

breadth of same=**41.56** ins. **Entrance Passage.**—Angle of descent of floor of the passage, Southward, is=**26° 28′**; length downward and Southward to the junction of the first ascending passage inside the buildings=**988** ins.; thence to Caliph Al Mamoun's broken entrance-way=**214** ins; thence by the same incline, to the Well's lower mouth=**2,582** ins.; thence to the end of the inclined passage=**296** ins.; thence in a horizontal direction to the North wall of the Subterranean Chamber=**324** ins.; whole length of descending Entrance Passage=**4,404** ins. Bore, in horizontal subterranean region, for height=**36** ins., and breadth=**33** ins. **Subterranean unfinished Chamber**, length E. to W. **552** ins., breadth N. to S. **325** ins. Flat finished Ceiling, floor not yet cut out of the rock, and walls not full depth. **Ascending Passage**, (Lime-stone) starts in an upward and Southward direction, from a point on the descending entrance-passage, 988 inches inside the Pyramid; and the first 180 inches of its length is still filled up with fast-jammed granite plugs. The whole length, from the descending passage, up to the junction with, and entrance into the Grand Gallery is 1,542.4 inches. Angle of the floor's ascent, Southward= 26° 8′. Height and breadth, the same as entrance passage, anciently; now, in broken state, somewhat larger. **Grand Gallery**; (Lime-stone).—Length of inclined floor line, from N. to South wall is=1882 ins. Measured angle of ascent, Southwards=26°17′. Vertical height, at any one **average** point=339.5 inches. There are 36 overlappings of the roof, and 7 of the walls; the ramps, are 21 inches in height by 20 in breadth. The floor between the ramps is 42 ins., and the breadth of Gallery above the ramps, is 82 ins. At the Southern end of Gallery, there is a great step, 36 ins. in vertical height, by 61 ins. on the flat top from N. to South. Length horizontally from G. G. to ante-chamber 52.5 ins. Upper exit, at top of Eastern wall at its Southern end, is 33 ins. in height by 20 in breadth, nearly and roughly. **Ante-Chamber**; (Lime-stone and Granite).—Length, N. to S. 116.26; breadth at top, E. to W. 65.2; and height, 149.3 ins. Eastern wainscot, granite, 103.03 and Western wainscot, granite, 111.80 ins. in height. Granite (density=0.479, earth's density=1) begins to be employed in the course of the length of this room, and in the **Granite-Leaf** which crosses it, at various distances, as 8 to 24 ins. from North wall, in floor, and side walls. Exit passage, horizontal, from ante-chamber, Southward to King's Chamber, in granite all the way; length 100.2 ins.; height at North end, 43.7, and South end 42.0 ins.; breadth 41.4 ins. There are 4 grooves on the South wall, that are each 107.4 ins. in length. **King's Chamber** (Granite). Structure entirely in granite, form rectangular, length 412.132; breadth 206.066 ins.; height, floor to ceiling, 230.389; base of walls to ceiling, 235.350 inches. The walls are in 5 equal height courses, and composed of 100 blocks. Within the dark King's Chamber is a **Coffer**, and termed, according to various writers, stone box, granite chest, lidless vessel, porphyry vase, black marble sarcophagus and coffer. It is composed of a darkish variety of red, and possibly syenitic granite; now, much broken, and over one-third of which has been carried away. The following are the (supposed) ancient measurements, by Piazzi Smyth.

Measures of the Coffer in Pyramid Inches.

Length outside, from 89.92 to 89.62, corrected for concavity of sides; breadth outside, 38.68 to 38.61; height outside, 41.23 to 41.13. Inside measures: length, 77.85; breadth, 26.70; depth, 34.31. Thickness of bottom, 6.91; thickness of sides, 5.98. Exterior cubic size=142.316; interior cubic contents 71.317, with a possible error of .159 of a cubic inch in the measurement; if so, the exterior is just double the interior cubic contents. The cubic capacity of the King's Chamber, is just 50 times that of the Coffer; the floor of which stands upon the 50th course of masonry of the whole building, and 1,686 inches vertical above the pavement, upon which the Pyramid stands. In addition to the above, regarding the King's Chamber, it is shut out from the light of day by walls nearly 180 feet in thickness, with a temperature almost unvarying the year round; as a depository of weights and measures, it is the best on the face of the earth. **Queen's Chamber**, (Lime-stone). Length of the horizontal passage, to the Queen's Chamber, from the North end of the Grand Gallery, Southward, to the beginning of low part of the passage under G. G. floor=217.8 ins., thence to low portion of floor=1,085.5 ins., thence to North wall of Queen's Chamber=216.1 ins. Average height of longest part=46.34; of Southern deep part=67.5; and breadth 41.15 inches. Length of Queen's Chamber, from E. to W.=226.7; breadth, N. to S.=205.8; height of ceiling at N. and S. walls =182.4; height in centre of gable ridge of ceiling=244.4 ins. Height of Grand Niche in the East wall=183.0; breadth, greatest, below=61.30 inches; it contains 4 overlaps, varying in breadth from 19.50 at the 4th to 52.25 inches at the first; and is removed Southward from the central vertical line of the wall just one Pyr. cubit, or 25 Pyr. inches. **The Well**; (Lime-stone), enters near Northwest corner of Grand Gallery, the shaft is square bore, length of side of bore 28 inches. Vertical depth to grotto in the rock, under masonry of Pyramid=702; thence vertical, with some horizontal distance, to lower part of entrance passage near Subterranean Chamber=1,596. inches.

(Sec. 10.) Among the Jeezeh Pyramids, there is one that transcends in intellectual value all the rest; one that has been involuntarily by all the world named for ages past the "Great Pyramid"; and which stands out the more it is examined into, distinct and distinguished from all the rest by its particular size, and wonderful internal structure, superior age, and more frequent historical notice by men of various nations. The greatest of the "seven wonders of the world" in the days of the Greeks, and the only one of them all, which is still in existence on the surface of the earth.

We quote from "Our Inheritance in The Great Pyramid," by *Piazzi Smyth*.—"But as we approach, ascending the stream of ancient time, in any careful chronological survey of pyramidal structures, to the "Great Pyramid," Egyptian emblems are gradually left behind; and in and throughout, that mighty builded mass, which all history and all tradition, both ancient and modern, agree in representing as first in point of date of the whole Jeezeh, and even the whole Egyptian group, the earliest stone building also positively known to have been erected in any country,—we find in all its *finished* parts not a vestige of heathenism nor the smallest indulgence in anything approaching to idolatry; nor even the most distant allusion to Sabianism, and its elemental worship of sun, or moon, or any of the starry host."

In certain unfinished, internal portions of the constructive masonry of the Great Pyramid broken into by Col. Howard Vyse in 1837, there are some (said to be rude *Egyptian markings*) daubs of red paint, evidently numbers for temporary mechanical purposes only; which, if understood, might give a key to the language of the race of people that preceded our race; it is not Egyptain. (Further on we will quote from the "Source of Measures" by Skinner, to show that the origin of language was number).

We also except, as a matter of course, any inscriptions inflicted on the same pyramid by modern travelers, even though they have attempted, like the Prussian *savants* of

1843 A. D., to cut their names in their own happily shallow ideas of the ancient hieroglyphics of the old, thorough-paced, Egyptian idolaters elsewhere. But with these simple exceptions we can most positively say, that both exterior and interior are absolutely free from all engraved or sculptured work, as well as from everything relating to any known form of idolatry or erring man's theotechnic devices. From all those hieratic emblems, therefore, which from first to last have utterly overlaid every Eygptian temple proper, as well as all Egypt's obelisks, sphinxes, statues, tombs, and whatever other monuments they, the Egyptians, did build up at any certain historical and Pharaonic epoch in connection with their peculiar belief."

Was the Great Pyramid, then, erected before the invention of hieroglyphics, and previous to the birth of the different Egyptian religions? It most certainly was.

To quote and comment on the thousand and one publications that have been published from time to time on this great structure, would require hundreds of pages, and months of time, to combat the absurd theories that are extant. But the following extract from Col. Howard Vyse's "Pyramids of Gizeh,"published in London in 1840, will not be out of place here. Both he and Piazzi Smyth concluded as self-evident, that the early Egyptians did build the great pyramid (with the aid of a Deific Architect) because of the red paint marks being in some kind of an (or supposed) Egyptian language. There is no Egyptian tongue, in hieroglyphics or otherwise yet discovered, but what has been interpreted; (this in red paint has not).

"This very important conclusion results from the quarry marks of the workmen being found in red paint on concealed parts of the stones and in interior places of the structural mass of masonry never intended to be seen. The marks are superficial and rude in the extreme, but are evidently in the Egyptian language or manner freely handled; and in so far prove that they were put in by Egyptians, and of the age or under the reign of that Egyptian king variously called Shofo, Khufu and Cheops. They are excessively rough, no doubt, but quite suficient for their alleged purpose, viz., checks for workmen, whereby to recognize a stone duly prepared according to orders at the quarry, miles away and to see it properly placed in its intended position in the building. Still further, that these marks were not meant as ornaments in the structure, or put on after the stones were built into it, is abound-dantly evidenced by some of them being upside down, and some having been partly pared away in adjusting the block into its position; and, finally, by the learned Dr. Birch's interpretation of a number of the marks, which seem from thence to be mostly short dates, and directions to the workmen as to which stones were for the south, and which for the north, wall. These marks, moreover, have only been discovered in those dark holes or hollows, the so-called 'chambers,' but much rather 'hollows of construction' broken into by Col. Howard Vyse above the 'King's Chamber' of the Great Pyramid. There, also, you see other traces of the steps of mere practical work, such as the 'bat-holes' in the stones, by which the heavy blocks were doubtless lifted to their places, and everything is left perfectly rough. Nor was there the least occasion for finishing it up, rubbing out the marks, or polishing off the holes, for these void spaces were sealed up, or have been built up outside in solid masonry (excepting only the lowest one, known for a century as 'Davidson's Chamber,' and having its own small passage of approach from the southeast corner of the Grand Gallery) and were never intended to be used as chambers for *human visitation or living purposes. In all the other chambers and passages, on the contrary, intended to be visited, and approached by admirably constructed white stone passages, the masonry was finished off with the skill and polish almost of a jeweler and in them neither quarry marks nor 'bat holes' nor painted marks, nor hieroglyphics of any sort or kind are to be seen; excepting always those modern hierogylphics which Dr. Lepsius put up over the entrance into the Great Pyramid 'on a space of five feet in breadth by four feet in height.' in praise of the then sovereign of Prussia and which recently (1870) misled a learned Chinese envoy, by name Pin-chi-un, into most absurdly claiming a connection between the Great Pyramid and the early monuments of his own country."

* How should he know? He had never taken a degree in any secret order in his life, up to that period. THE AUTHOR.

Piazzi Smyth's 4th edition (in 1880) reads: "The numerous *quasi*-copies, for *sepulchral* purposes, of the Great Pyramid, which are now, in the shape of other pyramids, to be observed further south, along that western side of Egypt; always betraying, though, on close examination the most profound ignorance of their noble model's chiefest internal features, as well as of all its niceties of angle and cosmic harmonies of linear measurement. And such mere failures, as those later *tombic* pyramids, and never found, even then, at any very great number of miles away from the sight, nor any great number of years behind the date, of the colossal parent work on Jeezeh hill. The ostensible architectural idea, indeed, of that one grand primeval monument, though expensively copied during a few centuries, yet never wholly or permanently took the fancy of the ancient Egyptians. It had, or rather simulated before them to have, some one or two suitabilities to their favorite employment of lasting sepulchure, and its accompanying rites; so they tried what they knew of it, for such purpose. But they soon found that it did not admit of their troops of priests, nor the easy introduction of their unwieldy 'sacred' animals. Nor bulls, nor crocodiles, nor the multitude of object worshippers, could enter a pyramid with the facility of their own temples; and so, on the whole, mature Egypt preferred *them*. Those accordingly more open and columned, as well as symbolically sculptured and multitudinously inscribed structures, of their own entire elaboration, are the only ones which we now find to have held, from their first invention, an uninterrupted reign through all the course of ancient and mediæval Egyptian history, or that period when Egypt was most rich, most powerful, most wicked; and to reflect themselves continuously in the placid, natural Nile, from one end of the long-drawn Hamitic land to the other. They, therefore, those Karnac and Philœ temples, with all their sins of idolatry on their heads, are architecturally, Egypt. Thebes, too, with its hundred adorned Pylon temple gates, and statues, and basso-relievos, and incised outlines of false gods, must be confessed to be intensely Egypt. But the Great Pyramid is, in its origin and nature something pure and perfectly different.

Under whose direction then, and for what purpose, was the Great Pyramid built; whence did so foreign, and really untasteful, an idea to Egypt come; who was the mysterious carrier of it to that land; and under what sort of special compulsion was it that, in his day, to his command though he was not their king, the Egyptians, King and people all alike, labored for years in a cause which they appreciated not; and gave, in that primeval age of generally sparse, and pastoral population only, their unrivalled mechanical skill and compacted numerical strength for an end which they did not at the time understand, and which they never even came to understand, much less to like, in all their subsequent national ages?

This has been indeed a mystery of mysteries, but may yet prove fruitful in the present advancing age of knowledge of all kinds to inquire into further; for though theories without number have been tried and failed in by ancient Greeks and mediæval Arabians, by French, English, Germans, and Americans, their failures partly pave, and render so much the safer, for us the road by which we must set out. Pave it poorly, perhaps, or not very far; for their whole result has, up to the present time, been little more than this, that the authors of those attempts are either found to be repeating idle tales, told them by those who knew no more about the subject than themselves; or skipping all the really crucial points of application for their theories which they should have attended to; or finally, like some of the best and ablest men who have given themselves to the question, fairly admitting that they were entirely beaten. Hence the *exclusive* notion of temples the sun and moon, or for sacred fire, or holy water, or burial places, and nothing but burial places of kings, or granaries for Joseph, or astronomical observatories, or defenses to Egypt against being invaded by the sands of the African desert, or places of resort for mankind in a second deluge, or of safety when the heavens should fall, have been for a long time past proved untenable; and the Great Pyramid stands out now, far more clearly than it did in the time of Herodotus (no less than 2,440 years ago), as both a prehistoric monument, and yet, rivaling some of the best things of modern times, not only in practical execution and workmanship, but in its eminently grand design and pure conception; or in forming a testimony which, though in Egypt, is yet not at all of, nor according to, historical Egypt, and whose true and full explanation must be still to come."

Piazzi Smyth was not the first writer on Egyptology and pyramidal building to suggest the interposition of God in the construction of the Great Pyramid by Deifying its Architect; that credit (if any) is due to Mr. John Taylor, of London, who in his work entitled "The Great Pyramid: Why Was It Built and Who Built It?" published in 1859, gave the first publicity to that theory. It would take at least a dozen pages of this work to even epitomize his theory; he was not only a devoted student regarding all that was said or written on the subject of the pyramids, but a devout and over-zealous Christian; he looked upon all the ancient Egyptians (or what he termed ancient, within the last 5,000 years) as a race of idolaters, and as such, totally unfit to erect a structure that would harmonize with anything as great and good, as he had traced in the construction of the "Great Pyramid." His carefull investigation of the different theories (and they were "legion") placed him in the front rank to suggest something new. As nearly every theory under the sun had already been suggested (in a secular way) he saw nothing left but a miracle to harmonize its different parts, so, interposing the mathematics of the Scriptures, regarding time (past and future dates), height, dip, angle, weight and measure, and from the squaring of the circle, to the distance to the sun; he had also the second coming of the Saviour fixed for the year 1881. Also, the harmonious measurement of the Garden of Eden, Noah's Ark, King Solomon's Temple, etc. Piazzi Smyth came on the scene before the demise of Mr. Taylor, who died July 5, 1864; they had many pleasant audiences, and the Royal Scottish Astronomer (Smyth) was thoroughly converted over to the theories of Mr. Taylor, and he kept the world interested, and guessing for nearly twenty years more. He lived, however, to see the year 1881 pass, without the second visitation of the Saviour. During his life he spent over six months at the Pyramid Jeezeh and vicinity, in scientifically measuring the same; we firmly believe that his final comparisons of his own (previous) measures, and all the engineers, astronomers, and mathematicians that preceded him are more nearly correct than any other yet published. His "Life and Work" published in three volumes, about the year 1869, and his last work "Our Inheritance in the Great Pyramid," which reached its 4th edition in the year 1880, show great painstaking, and a desire to be correct (in his measurements at least), in all that he gave publicity to in his different issues. While we do not agree with him, in any particular, regarding his theory of the building of the great structure, or the date of its erection, and who its builders were, we shall quote his last verified measurements, believing that a just criticism will acquiesce in his conclusions.

GEOMETRICAL PROPORTIONS OF THE OUTER SURFACES OF THE GREAT PYRAMID.

(Sec. 11.) The first discovered mathematical proportions, with regard to the Great Pyramid's shape, was by Mr. John Taylor. That is, as derived from modern measures and calculations, which is that the Great Pyramid's height, in the *original condition of the monument*, when each one of its four sloping triangular sides was made into a perfect plane by means of the polished outer sloping surface of the bevelled casing stones, and when those sides, being continued up to their mutual intersections, terminated at, and formed the summit in, a point,—that its central, vertical height then was, to twice the breadth of its square base, as nearly as can be expressed by good monumental work, *as the diameter to the circumference of a circle.* Or that the vertical height of that Pyramid was to the length of one side of its base, when multiplied by 2, as the diameter to the circumference of a circle; *i. e.* as 1:3.14159—etc. Or as shown later by Mr. St. John Day, the area of the Great Pyramid's right section (*i. e.* a vertical, central section parallel to one of the sides of the horizontal base) is to the area of the base, as 1 to the same 3.14159—etc. Or as the same fact admits again of being differently expressed, the vertical height of the Great Pyramid is the radius of a theoretical circle, the length of whose curved circumference is equal to the sum of the lengths of the four straight sides of the actual and practical square base of the building. Which is neither more nor less than that celebrated practical problem of the modern ages, of "the squaring of the circle"; and the thing was thus practically done, at the Great Pyramid, thousands of years before the mediæval days of our forefathers. And we venture the opinion, that if we had the ability to measure the outer surfaces of that great "first wonder of the world" with *exactness*, that are stated above, that such measurement would be found to exactly square the circle without any remainder. (See index for squaring of the circle in another portion of this work.)

For it was so accomplished by the architect who designed that pyramid, when,—over and above deciding that the building was to be a square-based pyramid,—with, of course, all the necessary mathematical innate relations which every square-based pyramid *must* have,—he also ordained that its height, which otherwise might have been anything, was to bear such a particular proportion to its breadth of base, as should bring out the nearest possible value of *pi* as above mentioned; and which proportion not one out of any number of square-based pyramids would be otherwise necessarily endowed with; not one out of all the thirty-seven other measured pyramids in Egypt has been proved to be endowed with even approximately.

If, therefore, the quantity is really found built into the Great Pyramid with exactness, as well as magnitude, characterizing and utilizing the *whole* of that vast mass, it not only discriminates that building at once from all the other pyramids of Egypt, but proves that such a distinguishing feature must have been the result either of some most marvelous accident, or of some deep wisdom and settled, determined purpose; in this case, too, not less than 30,000 years ago. The royal Scottish astronomer, Piazzi Smyth, placed the date of the building of the Great Pyramid in the autumn of 2170 B. C.; because that was the time that a *Draconis* was crossing below the Pole, *and at the particular distance from the Pole indicated by the* (*supposed* north side) entrance-passage, in the autumn season of the Northern hemisphere of that year; *when the meridian of the equinoctial point of the heavens coincided with the Pleiades.* This was only about 4,076 years ago. Prof. H. L. Smith has shown that the circuit of the Pyramid, at the level of the King's Chamber, measures 25,827 Pyramid inches, which is the *exact number of years that it takes the procession of the equinoxes to repeat itself.* Therefore, 27,997 B. C. is the latest date that *we* place the completion of that "Great First Wonder of the World"; and it may have been a multiple of that procession and carried the date back to 51,654 B. C., (of this, more hereafter).

The wisdom of the Great Pyramid's founders is so well exemplified, in its mathematical proportions, that it is conclusive evidence of the double intent of its purpose; in addition to the schooling of its *Initiates*, it was intended as an International depository of "Weights and Measures." And, evidently, intended to last for the inspection of a most distant posterity; knowing well that a fundamental mathematical truth like *pi*, would infallibly come to be understood both in and by itself alone, and be appreciated in the fact without any written inscription, in that then distant day when mathematics (or numbers) should again be the language of all mankind. (See quotation from the "Source of Measures" in another portion of this work.)

Our own experience teaches us, that neither mathematics nor mechanics can progress in any country without knowing well the numerical value and calculational value of *pi*. On the subject of *pi*, the respective authors are not only numerous, but their accounts of mensurations, as a rule, are most strangely contradictory. Colonel Howard Vyse, in Volume II. of his important work, "The Pyramids of Gizeh," published in 1840, gives extracts from no less than 71 European and 2 Asiatic authors, and as many more have been added since that date, on this momentous question. Unless a very great number be read, no sufficient idea can be formed as to how little faith is often to be placed in the narratives of even highly, though too exclusively mentally, educated men of modern university, and competitive examination, on a very simple practical matter.

Successive travellers (each of whom had published a book), could with ease, string together a series of so-called measures, on the same parts of the Great Pyramid, which would show its blocks of solid stone expanding and contracting between different visits to it, like elastic india-rubber air-bags. But it will suffice for the present to indicate the necessity of weighing the evidence in every case most scrupulously; to have a large quantity of evidence, a great variety of observers, and to place in the first rank of authors to be studied in the original, closely in every word they have written, but not necessarily to be always followed therein; they are:

PROFESSOR JOHN GREAVES, the Oxford astronomer in 1638.

The French, or Napoleon Bonaparte, Expedition in 1799.

COLONEL HOWARD VYSE, in 1837.

SIR GARDNER WILKINSON, from 1840 to 1858.

MR. JOHN TAYLOR, 1859 to 1863.

PIAZZI SMYTH, noted astronomer, from 1867 to 1880.

The Great Pyramid, at this writing, inspected externally, is a rough, huge mass, about 454 feet (English) high; the angle stones having been carried away, it looks like (from its four sides) so many steps. On close examination, these steps are represented by the different layers of stone, varying in height from 21 to 59 inches. As all the material above the 202 layer of stone has (like the original casing stones) been carried away, the top, with some irregularities, represents a floor of about 32 x 32 feet square. The whole structure is regularly and masterly built of worked and cemented limestone blocks, in horizontal sheets, or courses of masonry. (To what extent these sheets of masonry are absolutely continuous throughout the mass can never be known unless the whole structure is taken to pieces. Each stratum, however, records itself similarly on each of the four sides, excepting only the small interruption of a portion of rock at the *northeast corner*, and also a small hole filled with rubble work which is reported by Dr. J. A. S. Grant, as located about a third of the way up one of the sides.) The flattened top gives the pyramid at a distance an abnormally blunted-looking summit—mediæval dilapidations and forcible removal of the Pyramid's once polished white stone casing, with its outer surface bevelled smoothly to the general slope, (see plate) which has stood at least 30,000 years, and had in its day given to the structure almost mathematical truth and perfection. This state of things was that described by Greek, Roman, and early Arabian writers; and it existed until the Caliphs of Egypt, about the year 1,000 A. D., began methodically to strip off the polished and bevelled casing stone blocks; they built two bridges to convey them more easily to the river, after chipping off the prismoidal angles and edges; and then employed them in building mosques and palaces; for the lining of the great "Joseph" well, and for other public structures which still adorn their favorite city, El Kahireh, or the victorious—the Cairo of vulgar English. (During the year 1879, Dr. J. A. S. Grant and Mr. Waynman Dixon visited the celebrated Mosque of Sooltan Hassan, in Cairo, to see if any of the component blocks forming its walls could be identified as having belonged to the Great Pyramid; they found them to be undoubtedly of the same Mokattam stone, but too well squared to retain any of the outside bevelled surface. The inquiry was, however, put a rude stop to, by the Mohammedan janitors, before it had reached some of the more likely places near the top of the mosque, wherein to meet with an accidentally or carelessly left oblique surface of the other far older building.

The original, and not the present size and shape, is what we require and must have for testing Mr. John Taylor's measurements; and for approximating, by whatever degree of exactitude may be reached, to whether it was accident or intention which decided the shape of the Great Pyramid; and he has well pointed out that no one had any pretence to have obtained the old base side length until the French academicians, in 1799, cleared away the hills of sand and debris at the northeast and northwest corners, and reached beneath them the levelled surface of the living rock itself on which the Pyramid was originally founded. There, discovering two rectangular hollows carefully and truly cut into the rock, as if for 'sockets' for the basal corner stones, the said academicians measured the distance between those sockets with much geodesic accuracy, and found it to be equal to 763.62 English feet. The same distance being measured thirty-seven years afterwards by Colonel Howard Vyse, guided by another equally sure direction of the original building, as 764.0 English feet—the mean of which, or 763.81 feet, is close enough *for a first approximation* to the ancient base-breadth.

But the ancient height of the Great Pyramid, which we also need to have for instituting the calculation, is not at all easy to measure directly with any sufficient approach to exactness; chiefly because so very much of the original top has actually been knocked away during the middle ages so as to leave a platform described by the Arabs as "large enough for eleven camels to lie down," several feet therefore beneath the apex, where once the four sloping sides, or external flanks, of the building were continued up to, and terminated in, a sharp point. Colonel Howard Vyse's providential finding of two of the ancient "casing-stones" in their original situation, with their sloping faces, at the foot of the Pyramid, was the keystone to John Taylor's first efforts in obtaining the ancient height of this great structure, for they enabled the problem to be attacked in a different manner, and without any dependence on the missing portion at the top; or by angular, as contrasted to, but afterwards made to furnish an idea of, linear, measure. For such angle can give forth by *computation* a *complete* verticle height, to be used with the already obtained, by *measure*, complete base-breadth.

(Sec. 12.) OBJECTORS TO THE MEASUREMENTS AND CONDITION OF THE GREAT PYRAMID, loom up, and assert their opinions in all parts of the earth; some of them filling the highest positions in their several countries. Two prominent members of the Royal Society of Edinburgh, in 1867, after listening to a lecture on the exterior of the Pyramid, remarked: First objector, an engineer, said "that he had twice passed through Egypt, been to the Pyramids, saw no symptoms of casing stones, and therefore would not believe in anything about them;" Second objector, an Indian naval officer, had also been to the Pyramids on a visit, and "found such heaps of rubbish about the great one, that he could not see how any man *could* measure even its base side length with any degree of correctness, much less the angle of casing stones which he also could not see."

Both speeches, although uttered by men of rank, are only too faithful examples of the small extent of information on which many persons of commanding social rank, will even yet persist in speaking most authoritatively on both the present and past state of the Great Pyramid. The engineer above referred to, questioning the existence of the casing stones, should at least have read the accounts of Herodotus, Strabo, Pliny, and many of the early Arabian authors too, who described what they saw with their own eyes, when the casing was still complete, eminently smooth, and by all men, who had seen them, called beautiful. Next he should have taken up Colonel Howard Vyse's book, describing in detail how he succeeded, after immense labor with hundreds of workmen, in digging down to, finding, and measuring probably the last two of the northern side's bevelled blocks; (still were they in their original situation, and adhering closely by their original cement to the pavement base of the building) and then how he failed, though he covered them up again with a mound of rubbish, pending an application to the English Government to remove them to the British Museum—how he failed to save them from the hammers of Mohammedan prowlers by night; deadly jealous as they were of Christians obtaining anything really valuable from the country *they* ruled over. Besides which, the large amount of casing stones, bevelled externally to the slope, still existing upon other pyramids, as on the two large ones of Dashoor; the well preserved ones of second Jeezeh Pyramid, conspicuous near its summit, and on a bright day "shining resplendently afar," as says M. Jomard; and the granite ones of the third pyramid, so excessively hard that modern workmen have not cared to have much to do with them—all this, which has long been known, should effect much in convincing unwilling minds as to what was the *original* state of the outside of the Great Pyramid, previous to the year 840 A. D. About forty years ago a similar case of spoilation was perpetrated, on the south stone pyramid of Dashoor, by Defterdar Mohammed Bey in order to procure blocks of ready cut stones of extra whiteness wherewith to build himself a palace near Cairo. The foregoing historic recorded facts should have convinced Objector No. One, as far back as the year 1864.

Replying to (the Indian Naval Officer) Objector No. Two, about the possibility of other men succeeding in measuring what would have puzzled him as he looked idly, and never held a measuring rod of any kind in his hand, should have read the whole account of the active and hard working French Academicians in Egypt; of which the following from "Antiquities, Description," Vol. II., is worthy of being more generally known than it seems to be: *viz.*, that after digging down through the rubbish heaped up about the lower part of the Pyramid, "They recognized perfectly the esplanade upon which the Great Pyramid had been originally established; and discovered happily, at the northeast angle, a large hollow socket (*encastrement*) worked in the rock, cut rectangularly and uninjured, where the cornerstone (of that one basal angle) had been placed; it is an irregular square, which is 9 feet 10 inches broad English measure, in one direction, and 11 feet 5.8 inches in another, and 7.9 inches deep" all over its floor (measures since then were tested by Piazzi Smyth, but only after several days spent in digging and clearing the locality over again by a civil engineer with a party of Arabs). The French *savants* made the "same research at the northwest angle, and there also discovered a hollow socket (*encastrement*) similar to the former; the two were on the same level. It was between the two exterior points of these hollows and with much care and precaution, that they measured the base side length. They found it 763.62 English feet." The 'encastrement' so brought to light in the basal rock at the northwest angle, is duly figured in the plan amongst the large French plates; and since verified by Piazzi Smyth, has the inner corner curiously pared away, evidently indicating the well-shaped rectangular *outer* corner to be its true starting point for measure; and because, also, it was originally the terminal point of the Pyramid's material at that lower angle or foot. From the outer corner of the northeast to the outer corner of the northwest 'encastrements' of their happy discovery it therefore was, that the skillful French surveyors extended their measuring bars, and with the result given above. They also triangulated the ground round about, and from thence measured the altitude of the *present* depressed and flat topped summit of the Great Pyramid with an accuracy which would have been quite enough for any ordinary remnant of archæological structure. The Great Pyramid, however, has to undergo severer tests; as there has been no ancient trustworthy mark at the apex of this building since about the year 1,000 A. D. to enable *savants* to supply the exact quantity of the now missing portion of the original summit, we have, after all, for restoring that, to return to the angular inclined plane of the two original casing stones below, so happily uncovered by Colonel Howard Vyse in 1837, and proved by him to have been the very beginning of the northern upward sloping side of the building.

THE CASING STONES found by Howard Vyse, were of extreme value. These angular relics were of the original number of the casing stones, and actually *in situ* and undisturbed, and therefore showing what was once the real outside of the Great Pyramid, *viz.*, smooth, polished, dense, white limestone, almost like marble, in a sloping plane; not because they exhibited such matchless workmanship, more correct and true than the work of a modern optical instrument maker, but performed in this instance on blocks of a height of nearly 5 feet, a breadth of 8 feet, and a length, perhaps, of 12 feet; with the finest of joints, said to be no thicker, even including a film of white cement, than "silver-paper." The angle of the bevelled or inclined outer surface, measured very carefully by Mr. Brettel, a civil engineer, for the Colonel, came out 51° 50′; and being computed from linear measures of the sides, made for him by another engineer, came out 51° 52′ 15.5″. The results are not identical, and might have been made better, with more care at the time; but yet extremely close with one another, as compared with the French angular determination (before there was anything on which to determine accurately, other than the present ruined and dilapidated sides of the edifice) of 51° 19′ 4″; or of previous modern observers, who are actually found anywhere, between 40° and 60°.

JOHN TAYLOR'S THEORY IS SUPPORTED BY HOWARD VYSE'S CASING STONE ANGLE.—Taking everything into fair consideration, the ancient angle of the Great Pyramid's slope may be considered to be somewhere between the two measured quantities of 51° 50′ and 51° 52′ 15.5″; there are many other reasons for believing that it *must* have been 51° 51′ and some seconds. How many mere seconds, modern mathematicians are not competent to decide; and a second of space is an exceedingly small quantity even in the most refined astronomical observations. If we assume for the time 14.3″ and employ the whole angle, *viz.*, 51° 51′ 14.3″, with the base-side as already given from linear measure = 763.81 feet (English), to compute the *original* height quantity which we have been aiming at so long, we have for that element 486.2567 (feet) of the same linear units. And from the values for the ancient height and base-breadth, computing the proportion of diameter to circumference, there appears 486.2567 : 763.81 x 2 :: 1 : 3.14159, etc. (John Taylor's figures for the vertical height and the base-breadth of the Great Pyramid were 486.764 feet; evidently the nearest possible approximation by whole feet. Further, we should mention that the height of the Great Pyramid, trigonometrically measured by the French *scientists*, is perfectly agreeable to the above computed result; for when it is increased by something more than 30 feet, to allow for the evidently missing portion at the summit, it amounts to the same thing.) This result so far shows, that the Great Pyramid does represent as closely as the very best modern measures can be trusted, the true value of *pi*; a quantity which men in general, and all human science too, did not begin to trouble themselves about until long, long ages; languages, and nations had passed away after the building up of the Great Pyramid; and after the sealing up too, of that grand primeval and prehistoric monument, of an age, which no one living today, can (exactly) determine.

CONFIRMATION OF JOHN TAYLOR'S THEORY BY PIAZZI SMYTH.—From the 4th edition of "Our Inheritance in the Great Pyramid:" "Hence the first stage of our trial terminates itself with as eminent a confirmation as the case can possibly admit of, touching the truth of John Taylor's theory, proposition, or statement; and now begins the second stage, wherein I can add the absolute weight of direct personal examination, as well as of practical researches carried on at the place by myself for a longer time and with better measuring instruments than any of my predecessors had at their command. I was not, indeed, so fortunate as Colonel Howard Vyse in finding anything like such large, entire, unmoved, and well preserved casing stones as he did; but was enabled to prove that the enormous rubbish mounds now formed on each of the four sides of the Pyramid consist mainly of innumerable fragments of the old casing stones, distinguishable both by the superior quality of their component stone and their prepared angle of slope always conformable, within very narrow limits, to Colonel Howard Vyse's determination. And a number of these almost 'vocal' fragments were deposited by me, on my return, in the museum of the Royal Society, Edinburgh.

"Also, by careful measures of the angle of the *whole* Pyramid along all four of its corner or arris lines from top to bottom, observed with a powerful astronomical circle and telescope, as more particularly described in my larger book, in 1865, the same result came out. For that *corner* angle so measured (see Plate) was found to be 41° 59′ 45″ nearly; and that gives by computation (according to the necessary innate relations of the parts of a square-based pyramid) for the *side* slope of this 'Great' one, 51° 51′ and some seconds; or without any doubt the representative of the angle Colonel Howard Vyse did observe on the *side* directly; and the one which, if it is there, necessarily makes the Great Pyramid, in and by its *whole* figure, express the value of that most scientific desideratum, *pi*.

"Nor has the proving of the matter stopped with me. For other explorers have now been induced to search the rubbish mounds about the Pyramid, and have seldom left without carrying off some fragment, wherein two evidently anciently worked sides met, not at a right angle, but at the angle of either 51° 51′ or 128° 9′, nearly; one being the angle at the foot, the other at the head, of every casing stone of a *pi* pyramid, if built as the Great Pyramid is, but some other Pyramids are not, in accurately horizontal courses of masonry.

"I learn, too, from an American book of travel, that my former Arab assistant in measuring the Great Pyramid, Alee Dobree by name, and who was very quick in seizing the idea of angle expressed in numerical amount when I first explained it to him in 1865—that he is now driving quite a trade, almost exclusively, with the travelers who visit the Monument, by selling them 'casing stone fragments with the angle'; which fragments he is able, by the gift of a sharp and appreciative eye, to pick out of the very same hills of rubbish they walk carelessly over.

"Yet even all his feats in that way have been far transcended by my friend, Mr. Waynman Dixon, C. E., who, taking advantage of an extensive cutting into the Great Pyramid rubbish mounds by the Egyptian Government merely for material wherewith to make the road by which the Empress of France visited the Monument in 1869, discovered almost a whole casing stone. Not a very large one, indeed, and a loose block only, but with portions more or less of all six original worked sides; or a completer example than is known at the present moment to exist anywhere else all the world over. This most unique specimen, Mr. Waynman Dixon graciously sent from Egypt as a present to me, and I have deposited it under a glass case in the official residence of the Astronomer-Royal for Scotland, where it has been closely measured, and its ascending angle found to be certainly between 51° 53′ 15″ and 51° 49′ 55″; or as close as could be expected, from the block's size and fractured condition, to be that typical 51° 51′ 14″ about which all the fragments of the Great Pyramid are found to collect. But none of the fragments of the other pyramids of Egypt do so. Their casing stones were sometimes worked with equal hand skill, so as to preserve one particular angle very closely over the whole surface of a large building, but it is always a wrong angle. The ability of head was wanting there, and meaningless angles of 43°, 50°, 57°, 63°, and even 73° occupied, and wasted the time of their workmen, if a mathematical demonstration and not a mere architectural adornment, was really their object. Closer up in the very neighborhood of the Great Pyramid, as on the hill of Jeezeh itself, some of the subsequent smaller imitation pyramids could hardly fail to be nearer their original, and were in fact, within half, or three-quarters of a degree of its particular angle. But they are constant all over their surfaces, and on every side at that deviation; and that so very large a one, as to throw *their* numerical value of *pi* into utter error; and leave the Great Pyramid the sole example throughout all Egypt of any building whatever, giving, by its whole proportions, or entire geometry, and within the closest limits of the best modern measures of it, the one, and only true practical expression for *pi* which modern science admits."

STANDARD OF LENGTH EMPLOYED IN LAYING OUT THE GREAT PYRAMID.

(Sec. 13.) Conceding the results arrived at by the most noted savants of the past, regarding the standard of length used in the architectural construction of the Great Pyramid, *viz.*, the "pyramid cubit of 25 inches" equal to 25.001 inches English; and that the said measure expresses exact *pi* in the different triangulations and measurements of that structure; and further, that the 12 inch rule, or foot measure, does not so express itself, we will proceed to the array of proofs that they jointly employ. Recomputing Mr. Taylor's circumferential analogy of that most notable of buildings, after his own manner, by linear vertical height and linear horizontal base-breadth, the quantities named on a previous page, were expressed in English feet, *viz.*, verticle height 486.2567 feet, and length of one side of base, 763.81 feet; but it is not therefore intended to imply that they, or indeed any foot measures, were employed by the ancient builders. Certainly the length, want of meaning, and inconvenience of the fractions obliged to be introduced (*by us*) in order to represent the (closest approximate), or *pi*, proportion of the one pyramid element to the other, in these particular, absolute, linear terms, tend to forbid the idea. (We, nevertheless, believe that architect and builders of the Great Pyramid knew the *exact* proportion, or the ratio of the diameter to the circumference of a circle without any decimal. One of the proofs offered for this is: that no two mathematicians or engineers, in our day and age, obtain *exactly* the same results in the measure of any part of this "First Great Wonder of the World.") As a foot measure was not likely, and the Egyptian cubit whose length was close to 20.7 English inches, gave similarly inconvenient fractions, what sort of standard of linear measure *was* likely to have been employed at the building, or rather by the actual builder and architect of the whole design of the Great Pyramid?

WHAT STANDARD WOULD SUIT *PI* ON THE SCALE OF THE GREAT PYRAMID?

Our first step of inquiry will be, to see if an equally exact proportion between linear height and twice base-breadth, to what our long fractions of feet gave, cannot be obtained from some simpler numbers. Take for instance 116.5 : 366.0. These do not give the value of *pi* exactly (and as far as we know) no simple numbers can, when the proportion itself (is considered, and) belongs to the incommensurables; but it is an astonishingly close approach and an admirable clearing away of fractional troubles in all approximate work, for such plain and small numbers to make; and the exceedingly trifling fraction (either 116.5014 : 366.0000, or 116.5000 : 365.9956, would be closer, but not so convenient in multiplication and division) and by which the one should be increased and the other decreased, does not, in the existing state of our pyramidal knowledge thus far, make much practical difference upon most of the questions which we shall have presently to take up. Are there, however, any other reasons that such of mere arithmetical convenience, why we should attach much significance, in the design of the Great Pyramid, to these particular numbers? There are some reasons of really grand suggestions. In the *first* place, 366, which represents here (for our arbitrary diameter of a circle 116.5) the *pi* circumferential analogy of that circle, is also the nearest *even* number of days in a year; or more precisely, of mean solar days in a mean tropical solar year (of the earth); or again, of day-steps in the circle of the earth's year, which year is the most important of all circles to the physical life of man. We now know, by modern science, that the exact number of these day-steps in such terrestrial year is, at this present time in the history of man upon the earth 365.2422 + an almost endless fraction of unascertained length. So that the proportion of the day to the year is in a manner another incommensurable; in practice, though not in theory, as interminable as *pi* itself; and yet for the ordinary purposes of life, all civilized nations now use 365 even; except in leap year, when they do, evenly also, make their year to consist of 366 days.

In the *second* place, it may be stated that the portion of the Pyramid employed as the chief datum of linear measure in the problem under discussion, *viz.*, the length of each side of its square base as determined by the 'socket' measurements, both of the French *savants* and Colonel Howard Vyse, when it comes to be divided into 366 parts seems to give each of them a length approaching to one round and even ten-millionth of the earth's semi-axis of rotation, or nearly 25 English inches. Equivalent, therefore, *if further and independent confirmation shall be obtained*, to the architect having laid out the size of the Great Pyramid's base with a measuring rod 25 inches long, symbolical in modern science of the earth's diurnal rotation on its axis, in his hand—and in his head, the number of days and parts of a day so produced in a year of the earth's revolution round the sun; coupled with the intellectual and instructive intention to represent that number of days in terms of that rod, on each base side of the building.

A DAY AND YEAR STANDARD INDICATED WITH REMARKABLE AND HARMONIOUS EARTH COMMENSURABILITY.—Piazzi Smyth says: "Now this is a feature, in all sober truth, if that quantity of length was really used intentionally as a standard of measure of the most extraordinary importance; for it is only since Newton's time that men knew anything exact about, or have attributed anything peculiar in its size to, the earth's axis of rotation as different from any other diameter thereof. It is therefore, to man evidently a result of modern, very modern science alone; and every modern civilized nation has, during the nineteenth century, been obliged to perform gigantic trigonometrical operations and "degree measurings," in order to arrive at any approach to accurate knowledge of the true length of that Polar earth-line, or rotation axis of the earth; and they are still pursuing the inquiry with most extensive establishments of well trained surveyors and scientific calculators. Their best results hitherto oscillate generally about 500,500,000 English inches within very narrow limits, though some of the results, from unavoidable errors of even the most advanced modern scientific mensurations, are as great as 500,560,000, and others as small as 500,378,000. Such then is the range of uncertainty in which England, France, Germany, America, and Russia are placed at this moment with regard to the size of the world they live on. And yet they are immensely closer in accord, and nearer to the truth, than they were only fifty years ago; while 1,000, 2,000, or 3,000 years since, even the most scientific of men knew nothing but what was childish about the size of that earth-ball on which it had pleased God to place His last and most wondrous act of creation—Man—to dwell, and play his part, for, who knows, how short a season.

"It is possible, then, that at a much earlier date still than 3,000 years ago, or on the primeval occasion of the founding of the Great Pyramid in 2,170 B. C. (which date we consider an impossibility, owing to the lack of intelligence at that period; 27,970 B. C. would come nearer) the author of the design of that building could have known both the size, shape and motions of the earth exactly, and have intentionally chosen the unique diameter of its axis of rotation as a physically significant reference for the standard of measure to be employed in that building? Humanly, or by human science finding it out then, and in that age, of course was utterly impossible. But if the thing was inserted there in grandly monumental fact—too grand, too often repeated and too methodic to be owing to accident—there was something of supernatural in its origination. And if traces of the supernatural in goodness and truth are attributable only to God and to his Divine inspiration, then this most ancient, yet still existing monumentalization of superhuman *contemporary* cosmical knowledge *of that time* must be one of the most remarkable facts that occurred at the beginning of the post-diluvial career of man, outside of Scripture history; and stands next in importance to Scripture itself for all intellectual and religious mankind to inquire into, as to how, and for what end, it was allowed or aided by the Almighty both to take place, and in a manner which has enabled it to last down to these days."

The above quotation from Piazzi Smyth's 4th edition of "Our Inheritance in the Great Pyramid" is significant of the man; his religious fever knew no bounds, so much so, that everything he found or discovered in science, not immediately explainable, he attributed to Deity. I am sorry that he is not now in the body to defend his pet theory. As he has passed to the beyond, let me address his friends and followers, (and they are legion), *viz.*, if a *special* Dispensation has protected this great stone edifice for (even as he suggests—4,000 years) all the time that the present race has been making history, then why should not that same Divine influence have been extended to the churches throughout Christendom? and if not as a whole to some isolated sect? that was better than the rest? The fact is—no building on the face of the earth (outside of the Great Pyramid) has withstood the ravages of time, the earthquake and the flood, one-half the number of years that this great stone building is known to have done (not counting the thousands of years that history does not record). We will try and answer both sides of this question. It is purely a physical reason; *viz.*, during the great seismic disturbances in San Francisco, Cal., in April, 1906, and Valparaiso, Chile, in July of the same year will do to illustrate; it is a noted fact: that the different churches (regardless of denomination) suffered more proportionately than the buildings occupied by the lowest callings on earth. And why (?) not because they were churches, but because that class of buildings are tall, and most of them have spires that are not earthquake proof, built of wood or brick that will not stand a two minute seismic vibration. The lightning plays similar pranks, and is no respector of persons aiming as it does at the highest points.

The other side of this question: Why has the "Great Pyramid" stood all these thousands of years, although taller than any church edifice in the world? And only three other buildings of any character excel it in height, *viz.*, the "Eiffel Tower," at Paris; the "Washington Monument," at Washington; and the "City Hall" at Philadelphia. All of which are built practically earthquake proof, and each contain conductors for directing the lightning peacefully to the earth. But why has the Great Pyramid stood? Nothing miraculous about it. The extraordinary intelligence of the race of mankind that flourished from 50,000 to 100,000 years ago, led them to *know*, that there was but one spot (and that of limited area) on the face of the earth (on land) but what had changed places with the waters of the earth, some of it several times, and would do so again at different (long) intervals. That spot is located in the geographical center of the land of the earth: in 29° 58′ 51″ N. Lat. and 31° 10′ 1″ E. Long.; where they erected the greatest stone structure that ever existed, or is in place today, *viz.*, the "*Great Pyramid Jeezeh.*" And when they did so they had scientific physical reasons for believing that it would stand until the earth should cease to obey its polarity and the orb itself disintegrate. And why? Because the earth, being unequally balanced (the water area containing about three-fifths and the land area about two-fifths), the land portion, or that portion of the land above water, is principally located north of the equator, the geographical center of which (or weight center) is located between the following extreme points: N. W. Alaska, and S. E. Australia; and N. E. Asiatic Siberia, and Cape Horn, South America, in the S. W.; or as above described, the spot whereon stands the "Great Pyramid." If you have followed carefully what we have stated in our chapter on earthquakes, tidal waves, and other seismic disturbances, you will grasp at our opinion, in the belief—that the earth is never perfectly quiet—no more so, than a human being. This *state* of *inquietude* ranges from the slightest sensation noted on the seismograph, to the sinking of a continent. During all such disturbances, great or small, there is a point within the earth (the center of its weight) that is almost perfectly quiet; that point being nearer the surface on one side of the earth than the other (owing to the inequalities of the weight on the surface) causes that same quietude to exist on the surface nearest that point. The strongest circumstantial evidence exists that that point is located 9 miles S. of W. of Cairo, in Egypt, where stands the "Great Pyramid Jeezeh." This building was there, arrayed in all its beauty, with its white limestone casing stones, from base to apex, when the second Pyramid of Jeezeh was built (or so reported) in the year 2,130 B. C.; the Great Pyramid was then so old that no human being *then living* knew when it was built. All history regarding the date of which is pure guess-work and totally unreliable. The fact that this building still stands, without the least crack in the whole structure, except those known to have been made by vandals, marauders, etc., since the advent of the present race of men, is sufficient evidence that the locality surrounding the Great Pyramid is the most quiet spot on the face of the earth. We do not know what influence is brought to bear on our frail orb, the earth, to cause it to change its polarity, or swing out of place and come back again; nor will we attempt to ascribe a theory for this freak of nature. For our present purpose, it will be sufficiently satisfactory to say that such phenomena have occurred (explained somewhat at length in a previous chapter). Our theory of the difference between a severe earthquake and a cataclysm, or its effects on the surface of the earth is: that the *earthquake* is caused by a force from within the earth, while a *cataclysm* is caused by a force without, or on the surface of the earth; and this occurs when the earth suddenly disobeys her polar attraction. The result of which is, to cause some continents to sink, with a corresponding amount of land to rise from the depths of the oceans. During such ordeal, the earth behaves in a similar manner that she does during an earthquake, except, that she revolves around the *point of least resistance* (having changed her course) with greatly accelerated speed. That pivotal point, we claim, must be where the Great Pyramid is located; for we believe that it has passed through several such ordeals. We deem no explanation necessary to prove that the Great Pyramid (or any other structure) would stand and remain unmoved, during such a calamity, if the disturbing matter moved evenly around the point on which the said structure stood.

INQUIRY OF A MORE RIGID CHARACTER INTO THE ABSOLUTE LENGTH OF THE BASE-SIDE OF THE GREAT PYRAMID.

(Sec. 14.) We desire to ascertain if the alleged fact is there; or to what degree of accuracy it is there. Prof. Smyth says: "For in all practical work of physical science and nicety of measurement, good scientific men know that nothing whatever can be ascertained absolutely, but only within certain limits of error; those limits becoming smaller as observation improves, but never entirely vanishing. Is then, the ten-millionth part of the earth's semi-axis of rotation, or 25.025 English inches (according to the best modern estimate of that axis, which in a manner, and with the shining of the sun to help, *makes* the days, of the earth, being 500,500,000 English inches long) multiplied by 365.-2422 (the now known number of solar days in a year), the true length of a side of the square base of the ancient Great Pyramid; and if it is not, by how much does it differ?

"The foregoing theoretically proposed quantity, or inches 25.025 x 365.2422, evidently amounts to 9,140 English inches, nearly. * * * The only admissible, because the only *socket-founded*, determinations of the base-side lengths that I was acquainted with were, 1st, the French one = 763.62 English feet = 9,163.44 English inches; and, 2nd, Colonel Howard Vyse's of 764 English feet = 9,168 English inches; and both of them are far too large. This error did not affect our determination in a previous chapter for the *pi* shape of the Great Pyramid; because we computed the height, in terms of this same base-breadth, by reference to an angle observed quite independently of any linear measure. But now we require to know more positively whether the numerical length then used was real, or figurative only; and when I was actually at the Great Pyramid in 1865, Messrs. Aiton and Inglis, engineers, succeeded in uncovering all four of the Great Pyramid's corner sockets, and then proceeded to measure from socket to socket every one of the four sides of the base; and with what result? They made them all shorter, far shorter; to me it was at first incredibly shorter than both the French and Howard Vyse determinations; for it was equal only 9,110 English inches on the mean of the 4 sides. Either their measures then must have been very bad and too short; or those of the French and Colonel Howard Vyse were also bad, but too long. And why was there so much badness amongst them? Mainly because the ground to be measured over is covered, and heaped, and thrown into horrible confusion of ups and downs by those hills of rubbish, formed by the fragments of casing stones (of which we treated at some length a few pages back). Very useful were they then, for the angular fragments they yielded, on being dug into and turned inside out; but dreadfully obstructive are they now, when an accurate linear measure over a long distance is wanted; and when like all distance measuring in surveying work, it must be in a straight and level line only, for ultimate use or reference. Each measurer hoped that he had cleverly corrected his really up and down measures over the hills and down into the hollows of rubbish, to what they would have been if the ground had been level—but when their severally independent measurements are brought together, behold how they differ! And this, remember, is modern science, so critical of the antique ages of the world.

"After much consideration I was inclined to divide the errors very nearly evenly between the several parties, in 1867; adopting therefore, neither the 9,168 or 9,163 on one side, nor the 9,110 on the other, but 9,142. And in 1869, when the Royal Engineer surveyors (of Great Britain), returning from the Sinai survey, went (according to orders) to the Great Pyramid, and announced, through their colonel at home, that the mean length of a side of its square base from socket to socket, was 9,130 British inches, they were nearer to the *theoretical* 9,140 than to any of the other *measured* results. But as there are internal features of evidence showing that none of the measures, not even the last, were accurate enough to be depended upon to the third place of figures (whether measured upon only one side, or all four sides, of the base considered *square* by everybody) all men are at this very moment left by the last Pyramid base-side measurers of modern times in this predicament—*viz.*, the theoretical length of 9,140 inches which would imply such almost unutterable wisdom, or such inconceivably happy accident, for that primeval time on the part of the designer of the Great Pyramid, is really found *amongst*, or as though it were the thing really and centrally certified to, by the best conclusions of modern measure. It is, indeed, notably confirmed by them; or may be asserted upon and by means of them, within such limits as *they* can confirm anything; and if those limits are coarse, that coarseness is entirely the fault of the modern measurers, not of the ancient building; which, founded on a rock (and an admirably firm and nearly unfissured hill of dense rock of nummulitic limestone, in nearly horizontal strata) could not possibly have expanded and contracted between the successive modern dates of 1799, 1837, 1865, and 1869 A. D., as the recent measurers seem at first, most absurdly, to imply. The variations, therefore, first from 9,163 to 9,168, then to 9,110 and then to 9,130, must be merely the plus and minus errors of the modern measures, or of men intending honestly to do well if they could, but erring involuntarily, sometimes to one side and sometimes to the other of absolute exactitude."

THE EARTH-AXIS AND YEAR-COMMENSURABLE, RESULT FURTHER INDICATED.—"Of course better measures than all that have been yet taken, might be made in the present age of science, and should be instituted forthwith, to clear up so notable a point in the primeval history of man; but the expense to be incurred in the preliminary clearing of the ground from those obstructing rubbish heaps of broken stones, to allow of accurate measuring apparatus being brought to bear effectually, is beyond the means of any private and poor scientific man and the Great Pyramid is not a favorite subject either with rich men or the powerful governments of wealthy nations; while the invaluable corner sockets, never properly covered up since 1865, are daily being trodden and cruelly broken down at their edges out of shape and out of size, so that we are not likely to see speedily, if ever, any better measurers of the Great Pyramid's base-side length than those already obtained. But as *they*, when considered by any experienced computer fully, honestly, and fairly, do *include* the theoretical 9,140 English inches, we are already justified so far (and we shall have in a future chapter signal confirmation from the interior of the Pyramid) in upholding the high degree of probability that the reason why the Great Pyramid (made already of a particular *shape* to enunciate the value of the mathematical term *pi*) had also been made of a particular *size*, was, in part, to set forth the essence of all true chronology for man in recording the order of his works, and in understanding the chief physical basis on which alone he is ordained to prosecute them, upon this earth. For evidently this *was* accomplished there, by showing that the number of times that the Pyramid's standard of linear measure would go into the length of a side of its square base, was equal to the number of days and parts of a day in the course of a year. That standard of linear measure being, moreover, with a marvelously complete appropriateness of symbology, the ten-millionth (or, in mathematical expression, the 10^{7th} part) of the length of the earth's semi-axis of rotation: or of half of that axis, by the earth's rotating upon which before the sun, that particular number of days for work and nights for rest is constantly being produced for all humanity in the course of the earth's annual revolution around the sun. Hence, there is here wheel within wheel of appropriate and wise meaning, far above all the then contemporary knowledge of man, and in-cating far more than any mere single case of simple co-incidence of numbers. A grouping, indeed it is, implying something vastly beyond mechanical accident on the part of the unknown ancient architect. The affair was, more-over, perfectly open, because it was on the surface, during all antiquity; and especially open during the days of the Greek philosophers in Alexandria, when the Great Pyramid was still complete in size and finish, with its bevelled casing stones forming the then outside finished surface of the whole and the ground round about so eminently free from both the present obstructions, and all others, too, accompanying ordinary mason's work, that Strabo declared the building looked as if it had descended upon its site ready formed from Heaven, and had not been erected by man's laborious toil at all. The question which chiefly troubled Strabo was —"What have the builders done with their *chips*? Here is the most enormous building in the world, constructed al-most entirely of stones squared by man's hand, so that the involuntary production of chips must have been immense; but none of them are to be seen; all around the Great Pyra-mid is a level area swept as clean as if no stones at all had ever been chipped or squared upon it." Yet what he could not discover, time and the weather of over 1,800 years since his day have abundantly revealed; for the said primeval chippings by the original masons (a totally different affair from, and on an enormously larger scale than the hills of rubbish of the casing stone fragments of Mohammedan time now to be seen about the building) were all thrown over the northern edge of the Pyramid hill, or firmly banked up against the natural cliff on that side, and levelled on the top so as to extend the esplanade on the northern front of the monument. And there, a good photograph from the northeast sand-plain shows them still to be; discriminating admirably between the natural hill, and this adventitious addition to it." (See Plate.)

REFERENCE TO THE GREAT PYRAMID'S NUMBERS.

(Sec. 15.) And the affair grows in wonder the further we inquire into it. For Mr. Taylor, led by the numbers of British inches which measure the earth's polar axis length —and other men, also led by the dominance of fives in the Pyramid's construction (as that it has five angles and five sides, including the lower plane of the base mathematically as one)—ventured the suggestion, that the author of the Great Pyramid's design both employed decimal and quinary arithmetic; and had, and used, as his smaller unit of measure one-fifth of a fifth part of his particular cubit, forming thereby, let us say in English, an *inch*. An inch, larger indeed than a British inch, but only by a thousandth part, *i. e.*, about half a hair's breadth; an apparently unimportant quantity, and yet it is that which enables the round, and at the same time grand, *Pyramid* number of *five* hundred millions of them, *viz.*, Pyramid, not British, inches, even to measure the length of the earth's polar diameter with exactitude.

With these truly earth-commensurable inches, the *day standard* of linear measure for the side of the base of the Great Pyramid is 5 x 5, or just 25 of them; and that length we shall call the cubit of the Great Pyramid's scientific design. But in *its own inches*, the side of the Great Pyramid's base, we must remember, will no longer now measure 9,140, but 9,131.05 inches. Next, as there are four sides to the Pyramid's base, the united length of all of them evidently equals 36,524.2 of the same Pyramid inches; or, at the rate of a round hundred of those inches to a day, the whole perimeter of the building (already shown to represent the theoretical *pi* circle) is here found to symbolize once again, in day lengths, 365.242, or the practical day and night circle of the year.

It is not ominously significant, that the ancient cubit of Pharaonic Egypt, 20.7 British inches long nearly, if applied either to the Great Pyramid's base-side, or base-diagonals, or vertical height, or arris lines, or any other known radical length of the building, brings out no notable physical fact, no mathematical truth. While the other length of 25.025 British inches, brings out in this and other cases so many of the most important coincidences of this earth we inhabit, as make the ancient monument, at once, speak both intelligibly and intellectually to the scientific understanding of all intelligent men of the present day, "withersoever scattered around the world."

No other pyramid in Egypt can presume for a moment to compete with the Great Pyramid in this all-important earth-axial 25 inch standard, and 365.242 day matter. That is, none of their base-side lengths, when divided by the number of days in a year, are able to show that crucial 10^{7th} of the earth's axis quantity, or anything near it, or anything else of cosmical importance. The general instinct, therefore, of the whole human race through all ages, in so readily and universally allowing, as it did, to the first Pyramid the surname of 'Great,' has been borne out beyond all that had been expected, by the application of modern measure and scientific research.

While the ancient base-side length of the Great Monument *has* been quoted so low as 9,110, it *has* also been quoted as high as 9,168 British inches, and in a manner to lead to the inference that 9,140 of those inches must be very nearly the true quantity.

Note the measures of the base-side lengths of the greatest of the *other* Pyramids of Egypt, taken in the same terms. When measured by Colonel Howard Vyse and his assistant Mr. Perring (the authors of the 9,168 inch measure for the Great Pyramid, and therefore rather liable to err in excess than defect)—they, that is, the respective *ancient* base-side lengths of those other pyramids, are reported thus:—

	British Inches.
Second Pyramid of Jeezeh	8,493
North Stone Pyramid of Dashoor	8,633
South Stone Pyramid of Dashoor	7,400
The Chief, or 'Great' Pyramid of Saccara	4,727
Third Pyramid of Jeezeh	4,254
The Chief Pyramid of Aboosier	4,317
Northern Brick Pyramid of Dashoor	4,200
Southern Brick Pyramid of Dashoor	4,110
Pyramid Base of Mustabat el Pharaoon	3,708
Foundation for a Pyramid at Aboo-Roash	3,840

We might go on through all the thirty-seven, continually diminishing, until the last of them. One of the pyramids of Aboosier has a base-side length of only 905 English inches.

(Sec. 16.) THE PYRAMID'S LINEAR STANDARD.—The nations of the world from the dawn of written history, down to, less than one hundred and fifty years ago, of their own selves and by their own knowledge, cared little about their national measures beyond their daily, social use as such; and knew nothing but what was childish with regard to the size of the earth; so that all our present exact acquaintance with it, as a reference for standards of length, is confined within the history (as above stated) of the last one hundred and fifty years. The French philosophers in the early portion of the last century, in fixing on the Meridonal quadrant of *surface* for their metre's derivation, did not take into consideration the fact, that the progress of geodesy would within the century reveal that the earth's equator was not a circle, but a rather irregular curvilinear figure, perhaps ellipsoidal on the whole, so that it has many different lengths of equatorial diameters, and therefore also *different* lengths of quadrants of the Meridian in different longitudes. Although a majority of the countries of the earth have adopted *a* "Metric System," it is noted, that at *least* fourteen different nations have each a different length for their 'Metre.' This, as a matter of course varies the weight of the 'gramme'; the following table will illustrate:—

WEIGHT OF THE GRAMME IN GRAINS by different communities; the second in the list is the one generally adopted.

15.432	15.4323488	15.433159	15.438395	15.44242
15.43234874	15.432349	15.434	15.44	15.44402
15.43234875	15.4327	15.43402344	15.4402	....

When the system was adopted by France the metre was assumed to be the ten millionth part of the quadrant of the meridian passing through Barcelona and Dunkirk. For the reason of the above named contention, we claim that the system as originally promulgated, can never become universal. Again, the French shipbuilder himself uses the fractional system to lay out a vessel's keel. And yet these things were all taken into account, or provided for by the great, and as yet, mysterious architect that directed the building of the Great Pyramid, probably over 30,000 years ago.

For a series of "Weights and Measures" based on the capacity of the 'coffer,' and other measurements in the Great Pyramid, see another portion of this work. We think they should be universally adopted. The ruling standard, the 10^{7th}, or ten-millionth part of the earth's polar semi-axis, shown to have been adopted by the architect of the Great Pyramid, by the general progress of all learning, to be the only sound and truly scientific reference which the earth itself possesses. Through the long mediæval periods of darkness, confusion, and war, not even the most progressive nation thought of such things as mathematics, geodesy, and linear standards; if not the same master mind, very much like Providence, prevented our *hereditary* and *quasi*-Pyramid, *smaller unit of measure*, the inch, from losing more than the thousandth part of itself. We believe that the Great Pyramid is the one necessarily material and memorial center from which those practical things, weights and measures, sometime in the misty past, were distributed. To whom, and when, is as yet *unwritten* history.

Sir John Herschel, after careful examinations of the subject of Earth-size and Sun-distance, stated "that a band encircling the earth, of the breadth of the base of the Great Pyramid, contains one hundred thousand million square feet." The built size of the Great Pyramid is here stated to bear such a remarkably round and even number, as its proportion to the created size of the natural earth, that an argument for intention rather than accident may spring therefrom, if it hold closely in fact and in sequence to other coincidences independently ascertained. The feet to be used on such an occasion can hardly be any other than Pyramid feet, or 12 Pyramid inches set in a line; and the part of the earth for the colossal band to encircle, what should that be? Though it is allowable in approximate work, to speak of the earth as a sphere, whose every great circle, or section through its center, will have the same length of circumference—early investigation at the Pyramid indicated to the contrary; and that its design successfully discriminated between the axis of rotation diameter, and any and every other possible diameter through the really spheroidal, or ellipsoidal, or chiefly flattened-at-the-poles figure, of the great mass of the earth.

LENGTH OF THE EARTH'S POLAR AXIS.

(Sec. 17.) Expressed in Pyramid inches, (0.001 of an inch longer than the English inch) the polar diameter, or axis of rotation of the earth, has been stated by different observers of the best modern schools of the present time to be either 499,878,000 or 500,060,000 Pyramid inches in length, or any and almost every quantity between those limits. The matter cannot, in fact, be determined much closer by the best measures of the best men in the present day; and although one nation publishes its own results to an arithmetical refinement of nine places of figures, that is not physical exactness; and it cannot convince any other nation of its correctness beyond the first three places of figures. Some of them may agree to four places, few or none of them to five or six or more places. Therefore, in this case and all other similar ones throughout this work, we shall try to simplyfy all numerical statements of measures by only entering the significant numbers as far as they can be depended upon. Hence the three ooo with which the above statements terminate are merely to give the proper value to the preceding figures, and not to indicate that any one man's measures of the earth gave forth an even number of inches in units, tens, hundreds, or thousands.

Colonel Clarke, R. E., chief mathematician of the Ordinance Survey of Great Britain, in one of his reports issued some 40 years ago, gave two different statements, arrived at by different modes of computation (reduced here from British into Pyramid inches) first as 499,982,000 and lastly as 500,022,000; leaving the reader to chose which he likes, or any mean between the two. The extremes of Prof. Smyth and Col. Clarke are represented in the accompanying table, without attempting to decide the correctness of either one.

TABLE OF THE EARTH'S SEVERAL DIAMETERS IN PYRAMID INCHES.

Parts of the Earth Referred to	Result with Clarke's Smallest Equatorial Diam. 1866	Result Adopted by Piazzi Smyth 1864	Result with Clarke's Largest Equatorial Diam. 1866
Polar Diameter.......	500,000,000	500,000,000	500,000,000
Diameter in Lat. 60°..	500,396,000	500,420,000	500,435,000
Diameter in Lat. 45°..	500,792,000	500,840,000	500,869,000
Diameter in Lat. 30°..	501,186,000	501,257,000	501,301,000
Diameter at Equator..	501,577,000	501,672,000	501,730,000

TESTING OF JOHN TAYLOR'S ANALOGY.

Having the data at our command, let us return to the Taylor-Herschel Pyramid analogy, which asserts that a "band of the width of the Great Pyramid's base-breadth encircling the earth, contains 100,000,000,000 square feet." An equatorial band is the only one which could encircle the earth in a great circle, and at the same time in one and the same parallel of latitude. We proceed, therefore, thus: from the equatorial diameter given above, we compute the equatorial *circumferences* by multiplying them by that almost magic number to work calculations with, the *pi* of the Great Pyramid and modern mathematics, or 3.14159, etc. Reduce them to Pyramid feet by dividing by 12, and next multiply by the already determined Pyramid base-breadth in Pyramid feet, *viz.*, $\frac{9131.05}{12} = 760.921$; the following results then come out, *viz.*—They all give smaller figures than the required 100,000,000,000; for the smaller equatorial diameter gives 99,919,000,000, and the largest equatorial diameter gives 99,949,000,000. Not absolutely true, therefore, with any allowable equatorial diameter, further than the first three places.

PYRAMID AND SOLAR ANALOGY.

(Sec. 18.) Something then further than earth-size reference had been deemed possible in the Great Pyramid; but it was at last obtained by Mr. William Petrie, C. E., in October, 1867, when he deduced the mean distance of the sun from the earth; in fact, the "Sun-distance," to be the quantity hitherto vaguely expected only. An enormous length of line, is this sun-distance; and before which the mere size of the earth vanishes into almost nothingness. Mr. Petrie had remarked, and naturally enough, that the circle typified by the base of the Great Pyramid has already been proved to symbolize a year, or the earth's annual revolution around the sun; and the radius of that typical circle had also been shown to be the ancient vertical height of the Great Pyramid, the most important and unique line which can be drawn within the whole edifice.

Then that line, said he further, must represent also the radius of the earth's mean orbit round the sun, however far away that may be; and in the proposition of 10.9, or 1 to 1,000,000,000; because, amongst other reasons 10:9 is practically, in one mode of viewing it, the shape of the Great Pyramid. For this building, notwithstanding, or rather by virtue of, its *pi* angle at the *sides*, has practically and necessarily, and closer than any of the modern scientific measures have come to each other, just such another angle at the *corners* (see Fig. 1 and 2, in Plate 18) that for every *ten* units which its structure advances inward on the diagonal of the base to central, nocturnal darkness, it practically rises upward, or points to sunshine, daylight and sky, by *nine*. Nine, too, out of the ten characteristic five angles and five sides being the number of those ten parts which the sun shines on in such a shaped Pyramid, and in such a latitude, at noon, through the greater part of a year; when the sun "sits on the Pyramid with all its rays," and the building is then said, as it throws no shadow at all, "to devour it." Further, when the sun enters *Libra*, on March 20th of each year, *at 12 o'clock noon*; and again when the orb enters *Aries*, on September 22nd, the sun stands poised directly over the apex of the Great Pyramid.

THE PYRAMID SUN-DISTANCE.—Mr. Petrie instantly proceeded to computation, reducing the 5,813 Pyramid inches of the Great Pyramid's height to English inches, multiplying them by 10.9, and reducing those inches to English miles—when he worked out the quantity *91,840,000* (nearly) of those miles. "Alas!" sighed he, "the analogy does not hold even in the second place of figures, for the real sun-distance by modern astronomy has been held during the last half century (this was 40 years ago) to be 95,233,055 miles." So he threw his papers on one side thinking he had erred altogether in the very conception, and then attended to other matters; until one fine morning he chanced to hear, that although the above number of ninety-five millions and odd miles, had been held so long by all the modern world—mainly because it had been produced by the calculations of the then last transit of Venus across the sun's disc, by a late first rate German astronomer (calculations so vast, so difficult, and with such a prestige of accuracy and power about them, that no living man cared to dispute their results) yet the astronomical world had been forced to awaken during the last few years to a new responsibility, and not only admit that the number might possibly be erroreous, even very erroneous (or actually in the second place of figures) but to institute many series of difficult observations on either side of the world at the same time, for endeavoring to determine what the correction should be. One group of astronomers of several nations declared the true mean sun-distance to be about 91,500,000 miles; and another group of the same and other nations declared it to be from 92,500,000 to 93,000,000 of miles. Mr. Petrie steps in and shows that the Great Pyramid results, which he had formerly allowed to drop from his hands, out of his exceeding respect to all modern science from the beginning of learning up to the year 1855 A. D., is *between* these two latest, and supposed best, of all the conclusions or so-called determinations; indeed, it is almost exactly the mean between the contending parties, and forms therefore in itself, in simplicity and antiquity a single representation of the whole of the numerous, laborious, and most costly sun-distance results of all humankind even up to the present age; and it is now safe to assert, that the investigations of all nations (since the above dates) have gradually come a little closer to Mr. Petrie's figures, as shown by his measurements of the Great Pyramid. And further, that in the near future, the principal nations of the earth will be led to acknowledge and *adopt* as a "key to the universe of measures" those to be obtained, from the Great Pyramid Jeezeh. Our advance in astronomical science in the last 3,000 years (not generally known) reads curiously, *viz.* "In the age of the Greeks, the distance attributed to the sun from the earth began with the infantine quantity of about ten miles; it increased slowly to 10,000; still more slowly to 2,500,000; then after a long delay, increased to 36,000,000, under German Keplar; to 78,000,000 in the days of Louis XIV., through means of the South African or trans-equatorial observations of the Abbe La Caille; and only at length reached the full quantity, and then clumsily overpassed it, at the beginning of the last century, under the leadership of German mathematical astronomy."

Quoting from "*Our Inheritance in the Great Pyramid*," 4th edition: "*Modern astronomers are involuntarily proving that Man, unaided by supernatural Divine Power, could not possibly have measured the Sun-distance accurately in the Age of the Great Pyramid; and yet it is recorded there with exceeding accuracy.*" The author, Prof. Smyth, should have added: that no living astronomer in this age, at this late day, can state the exact sun-distance; nor solve a much easier problem: "Give us the exact measurements of the Great Pyramid."

If the reader has noted our argument in the early part of this work, he should know what our answer would be to the above quotation; *viz.*, that a "Deified Architect" is out of the question at *any* period; and secondly, that as we do not place the date of the building of the Great Pyramid in 2,170 B. C., we escape the criticism of our ideal architect, living in an age of (almost) absolute mathematical and astronomical ignorance. While we do not claim sufficient inspiration to *assume* any fixed period for the erection of this "First Great Wonder," we are deeply *impressed*, that it was at some one of the dates in the misty past, when "*a Draconis*" (the pole star) was on the exact meridian either above or below the pole in the North. And those dates were: 2,170 B. C.; 27,969 B. C.; 53,767 B. C.; and

79,564 B. C., etc. As geology and astronomy have proved our orb to have been many millions of years in existence, it is safe to assume that it has been inhabited at least a half of million years. Also, that it has been depeopled a number of times. As the first date mentioned above occurred at a time within our recorded history, and *that* history records that no one living at that time and age had the architectural ability to direct such a structure; we *assume* that the very earliest date that it could have been erected was in 27,969 B. C.; and it might have been either of the previous dates mentioned. Before the people of the earth will be able to duplicate the Great Pyramid, they will have to re-discover (at least) the following "Lost Arts:" *viz.*, "perfectly hardened copper;" "overcoming gravitation;" "navigating the air;" "communicating (through the language of number) with the inhabited planets;" "a telescope with from 1,000,000 to 2,000,000 power;" also, more perfect mathematics; and measuring apparatus sufficiently correct, at least, to survey or measure the same object *twice* with the same result. The builders of the Great Pyramid knew all those things, to be able to accomplish what they did. This is why all those writers of the past, that have delved deeply into the mystery of that structure, "have Deified the architect," to be able to give an *apparent* answer. Of this, more hereafter.

IN REGARD TO THE HEIGHTS of the different stone structures of the world (see table of Pyramids in another part of this work), it will be noted that no other pyramid in all Egypt approaches nearer than 32 feet of the height of the Great Pyramid, and only three other structures in the world, at this date, exceed it in height; *viz.*, "the Eiffel Tower, of Paris, France, 984 feet, built of steel; the City Hall and tower of Philadelphia, Pa., 537 1-3 feet, the last 200 feet of which is steel; and the Washington Monument, at Washington, D. C., 555 feet, all stone." But no one of the latter named structures have any claim to mathematical proportions in their construction.

ORIENTATION OF THE SIDES OF THE GREAT PYRAMID.

The square base of the Great Pyramid is perfectly oriented, or placed with its sides facing astronomically due north, south, east and west; this fact abolishes certain theories to the effect that all phenomena of that Pyramid have to do with pure geometry alone; for, to pure geometry as well as to algebra and arithmetic, all azimuths or orientations are alike; whereas, one most particular astronomical azimuth or direction was picked out for the sides of the base of the Great Pyramid.

This point of *perfect* orientation *may* be possible in this our day and age but the fact that in all the wide world over, no other building large or small, can be said to possess this peculiar characteristic, hints at the fact that *it* is also to be classed as one of the "lost arts." The nearest approach to the Great Pyramid's orientation with which we are familiar, is the Mormon Temple, at Salt Lake City, Utah, which was engineered by the celebrated mathematician and astronomer, Orsen Pratt, in his day. Our belief in the fact that the Great Pyramid is *perfectly* adjusted to the four cardinal points of the earth is strengthened every time a new set of engineers attempt to solve this mystery; as no two of them agree within several minutes. Prof. Smyth states in his "Life and Work" that it only varies 4′ and 30″; the French engineer, Nouet (in 1878) placed the measurement to vary 19′ and 58″. And others too numerous to mention cause it to vary in opposite directions.

Prof. Smyth adds, "The more an astronomer looks into the pointings of a magnetic needle, the more full of serious uncertanities and vagaries he finds it. But the more he examines, by mechanical instruments and astronomical observations into the north and south of the axis of the world or the polar point of the heavens, the more admirably certain does he find *it* and its laws, even to any amount of microscopic refinement. No astronomer, therefore, in a fixed observatory ever thinks of referring to a magnetic needle for the direction of the north. The very idea, by whomsoever brought up, is simply an absurdity. And of course in my own observations at the Great Pyramid in 1865, I had nothing to do with occult magnetism and its rude, uncertain pointings, but employed exclusively, for the polar direction, an astronomical alt-azimuth instrument of very solid construction, and reading to seconds. In that way comparing the socket defined sides of the base, and also the signal defined axis of the entrance passage, with the azimuth of *Alpha Ursæ Minoris*, the Pole Star, at the time of its greatest elongation west; and after reducing that observed place, by the proper methods of calculation, to the verticle of the pole itself, the cynosure was reached."

GEOGRAPHICAL POSITION—FURTHER TEST BY LATITUDE.

(Sec. 19.) "Another test of nearly the same thing, not by angle, but by distance on the surface; and further, that the architect did propose to place the Great Pyramid in the astronomical latitude of 30° north, whether that exact quantity was to be practical or theoretical; while my own astronomical observations in 1865 have proved, from the results of several nights work, that it stands so *near* to 30° as to be in the latitude parallel 29° 58′ 51″.

"A sensible defalcation this, from 30° it is true, but not all of it necessarily error; for if the original designer had wished that men should see with their bodily, rather than their mental eyes, the pole of the sky, from the foot of the Great Pyramid, at an altitude before them of 30°, he would have had to take account of the refraction of the atmosphere; and that would have necessitated the building standing not in 30°, but in 29° 58′ 22″. Whence we are entitled to say, that the latitude of the Great Pyramid is actually by observation *between* the two very limits assignable, but not to be discriminated by theory as it is at present. The precise middle point, however, between the two theoretical latitudes being 29° 59′ 11″ and the observed place being

29° 58′ 51″ there is a difference of 20″ which may have to be accounted for. Though Dr. Hooke's question upon it would pretty certainly have been, can the earth's axis have shifted so little in 4,000 years with regard to its crust that the latitudes of places have altered no more in that length of time than a miserable 20″ of space. Unfortunately none of the Greek, Roman, Indian, Alexandrian, or any of the older observatories of the world, had their latitudes determined in their day closely enough to furnish additional illustrations for this purpose.

"At Greenwich, the oldest and best supported of modern European observatories, there has been a continued decrease in its observed latitude, with the increase of time. In the large volumes of its published observations, I find the latitude successively stated as: In 1876, 51° 28′ 40″; 1834, 51° 28′ 39″; 1856, 51° 28′ 38.2″. This change of 1′ 8″ in eighty years, implies a quicker rate of decrease than the 20″ at the Great Pyramid in 4,000 years—if the observations were perfect; but they are not, and it is said, I believe, that small errors in both the instruments and the tables of refraction employed *may* be found eventually to explain away the apparent latitude change. Hence, all the known practical astronomy of the modern world cannot help us in this matter; and if we apply to physical astronomy some of its great mathematicians of the day who are supposed to be able to compute anything, and have announced long since how many millions of millions of millions of years the solar system is going to last, these great computers also announced a few years ago that they had found the interior of the earth to be solid, and as stiff as hammered steel; so that *no* change of latitude *could* take place. But within the last few years, they have concluded again that the interior of the earth is fluid, and steadied only by vortex motion of that fluid; also, that in the earlier geological ages, long before man appeared on the scene, great changes of latitude did take place in those almost infinitely long periods and that, therefore, some *small* change of the same sort may have been experienced within human history; but it can only be a very small change, even as the Great Pyramid has already indicated."

GEOGRAPHICAL APTITUDES OF THE GREAT PYRAMID.

(Sec. 20.) The engineers and geographers under Napoleon Bonaparte, during his visit to Egypt, in 1799, were not slow to perceive how grand, truthful, and effective a trigonometrical surveying signal the pointed shape of the Great Pyramid gratuitously presented them with; and they not only used it for that purpose, as it loomed far and wide over the country, but they employed it as a grander order of signal, also, to mark the *zero meridian of longitude* for all Egypt.

It is plain to see that, in coming to this conclusion, they could hardly but have perceived something of the peculiar position of the Great Pyramid at the southern apex of the Delta land of Egypt, and recognized that the verticle plane of the pyramid's passages produced northward, passed through the northermost point of Egypt's Mediterranean coast, besides forming the country's central and most commanding meridian line; while the N. E. and N. W. diagonals of the building similarly produced, enclosed the fertile Delta's either side in a symmetrical and well balanced manner. (See Plate II.) But the first very particular publication on this branch of the subject was by Mr. Henry Mitchell, Chief Hydrographer to the United States Coast Survey. He, having been sent by the U. S. Government, in 1868, to report on the progress of the Suez canal, was much struck with the regularity of a certain convex curvature along the whole of Egypt's ("Lower Egypt's") northern coast. To his mind, and by the light of his science, it was a splendid example, on that very account, of a growing and advancing coast line, developing in successive curves all struck one after and beyond the other, from a certain central point of physical origination in the interior. And where? With the curvature of the northern coast, really the Delta land of the Nile, on a good map before him (see in a small way, Fig. 1, Plate II.) Mr. Mitchell sought, with variations of direction and radius carried southward, until he got all the prominent coast points to be evenly swept by his arc; and then looking to see where his southern center was, found it upon the great Pyramid; he immediately decided in his mind that "that monument stands in a more important physical situation than any other building yet erected by man." And the importance of its position does not end there. For proceeding along the globe due north and due south of the Great Pyramid, it has been found by a good physical geographer as well as engineer, Mr. William Petrie, that there is more earth and less sea in that meridian than in any other meridian all the equator around. For this reason, the Great Pyramid's meridian is caused to be as essentially marked by nature, in a general manner across the world from Pole to Pole, or rather from the North Cape of Norway to the diamond fields and Zululand of South Africa, as a prime meridian for all nations measuring their longitude from, or, "the unification of longitude."

Again, taking the distribution of land and sea in parallels of *latitude*, there is more land surface in the Great Pyramid's general parallel of 30° than in any other degree; so that the two grand, solid, man-inhabited earth lines, the one, of most land in any meridian, and the other, of most land in any other latitude, cross on the Great Pyramid. Finally, on a careful summing up of the areas of all the dry land habitable by man all the wide world over, the *center* of the whole falls within the Great Pyramid's special territory of Lower Egypt.

Commodore Whiting, of the U. S. Navy, is quoted as saying (in 1879) that the chief claim in his eyes to the Great Pyramid as a Zero of all nations' longitude "is not merely that it is so eminently set in the midst among all busier haunts of men, on its own side of the earth, but that its *Nether* meridian, or the continuation of its Egyptian meridian round the *opposite* side of the world, forms the most suitable possible line of locality for circumnavigators of the globe to change their day of reckoning, as they pass it, accordingly as they are proceeding from East to West, or from West to East; because that *Nether* meridian of the Great Pyramid ranges its whole length from South to North Pole, excepting only near Behring's frozen straits, through foaming, tossing sea; realizing, therefore, almost exactly the precise *Nether* meridian long desired by the late most eminent Captain Maury, in his grand and world-wide facilitations of the navigation of all nations."

There is every reason to believe that the dry land surface spot, which was central when the Great Pyramid was built, is central still, and will continue to be so until the end of the present races of men on the earth. We expect to be further enabled to illustrate, before closing this work, that the directors of the building of the Great Pyramid were not natives of Egypt, but came into Egypt out of a country having a different latitude and longitude, and went back again into that country of theirs immediately after they had completed the Great Pyramid in all its beauty and perfection; and that there, in their own country, though they were at the head of their calling as architects, yet they built no more Pyramids (although they had built many before). This will go far to indicate that they had been taught, and well knew of early time, that there was only one proper and fully appropriate and safe spot, all the wide and *round* world over, whereon to found that most deeply significant structure that they had been commissioned to build, with every detail of which they were perfectly familiar, but entirely unknown to the then wandering nomads of that vicinity.

The exterior of that great central building of the whole earth, the Great Pyramid, has furnished us much food for thought up to this stage of our theory; notwithstanding the almost ruinous continuous attacks of twenty nations upon its exterior there is still proof, when carefully studied and scientifically measured, in spite of all those dilapidations to prove (at least) its size and location—the like of which were never made out in all past time for any other building on the face of the globe, not even for a single one of the other Pyramids of Egypt, all of which err utterly in angle, size, and position. What may we not expect from the building's better preserved interior?

We will conclude this earliest division of our work with a complete epitome of the outside measurements, including the "Geography and Masonry Courses" of the Great Pyramid; from the average prevailing testimony of those who have measured and thoroughly investigated the subject scientifically.

PRINCIPAL MEASURES CONNECTED WITH THE GEOGRAPHY OF THE EXTERIOR OF THE GREAT PYRAMID.

(Sec. 21.) POSITION.—N. Latitude, 29° 58′ 51″; E. Longitude, 31° 10′ 1″.

	Pyramid Feet	Inches.
ELEVATION OF PAVEMENT BASE:		
Above the neighboring plain as now covered by sand	125	0
Above the average water level	145	10
Above the Mediterranean Sea level	215	0
Elevation of the lowest subterranean construction or subterranean excavated chamber above the average water level of the country	20	10
HEIGHT-SIZE:—Present dilapidated height verticle	*454	2
Ancient verticle height of apex completed, above pavement	484	$5\frac{1}{10}$
Ancient inclined height, at middle of sides, from pavement to completed apex	†615	$11\frac{1}{2}$
Ancient inclined height at corners, pavement to apex	†724	0

Ancient verticle height of apex above the lowest subterranean chamber................	584	7
BREADTH SIZE:—Present dilapidated base side length..........................	*745	10
Ancient and present base side *socket* length	760	11½
Ancient and present base *diagonal* socket length..............................	1,076	1¼
Sum of the two base diagonals	2,152	2½
Present platform on top of Great Pyramid, in length of side, roughly................	33	4
(It is flat, except in so far as it has four or five large stones upon it, the remains of a once higher course of masonry.)		
Ancient length of side of Great Pyramid, with casing stone thickness complete, at the level of the present truncated summit platform, roughly......................	48	4
Pavement in front, and round the base of the Great Pyramid, formed of stones 21 inches thick, at center of North front..........	33	6
A chasm or crack in both pavement and rock beneath, near the North front, extends to a depth of, more or less................	47	6

SHAPE AND MATERIAL:

Ancient angle of rise of the casing stones and the whole Great Pyramid, when measured at the side..............	51° 51′ 14.3″
Ancient angle of rise of the whole Great Pyramid, when measured at the corners or arris lines...................	41° 59′ 18.7″
Ancient angle of the Great Pyramid, at the summit, *sideways*...........	76° 17′ 31.4″
Ancient angle of the Great Pyramid at the summit, *diagonally*, or cornerways..........................	96° 1′ 22.6″

CASING STONE MATERIALS:—Compact white limestone from the Mokattam Mountain quarries on the east side of the Nile, with a density equal to 0.367 (earth's mean density equals 1).

* About † Nearly

GENERAL STRUCTURAL MATERIAL OF ALL THE RUDER PART OF THE MASONRY:—Nummulitic limestone of the Pyramid's own hill, with a density equal to 0.412.

Number of sides of the whole building, including the square base as one—4 triangular and one square........5

Number of corners of the whole building—4 on the ground and one anciently aloft.......................5

AREA, WEIGHT, ETC.:	*Pyramid Acres.*
Ancient area of square base of Great Pyramid	13.340
Ancient area of the square pavement, on which the Great Pyramid is supposed to stand, but which has only been tested as yet on the Northern side, probably	16.00
If the pavement extends the same width on the east, south and west sides, as it does on the north (?) then it is......................	17.75

The whole building from very base to apex is not solid masonry; but as clearly shown by the N. E. basal corner and indicated more or less at a point or two in the wall, and the descending entrance passage, includes some portions of the live rock of the hill. Such portion having been, however, trimmed rectangularly, and made to conform in height and level with the nearest true masonry course.

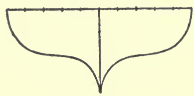
Solid cubits of masonry contained in the Great Pyramid's whole equals 10,340,000.

Tons (Pyramid) of squared, cemented building material equals 5,274,000.

UNITS OF MEASURE REFERRED TO.

1 Pyramid inch	1.001 English inch.
1 Pyramid foot	12.012 English inches.
1 Pyramid cubit	25.025 English inches.
1 Pyramid cubit	25.000 Pyramid inches.
1 Pyramid acre	0.9992 English acre
1 Pyramid ton	1.1499 English avoirdupois ton.

See also Plates III. to XX. inclusive.



ONE INCH OF THE GREAT PYRAMID

subdivided into tenths, equal in length to one 500-millionth of the earth's axis of rotation.

N. B.—The above pictorial representation must be considered approximate only, on account of the expansions and contractions of the paper it is printed on, from moisture.

MASONRY COURSES OF THE GREAT PYRAMID.

Table of the courses of squared and cemented blocks of stone in horizontal sheets, one above the other, which form the mass of the building. They vary from 20 to 79 inches in height.

Number of Course in Ascending	Height of Each Course in Inches, Roughly	Whole Height from Pavement, Ascending	Number of Course in Ascending	Height of Each Course in Inches, Roughly	Whole Height from Pavement Ascending	Number of Course in Ascending	Height of Each Course in Inches, Roughly	Whole Height from Pavement, Ascending
Pavement	0	0	26	26	933	52	26	1770
1	79	79	27	28	961	53	27	1797
2	56	135	28	31	992	54	24	1821
3	48	183	29	30	1022	55	26	1847
4	40	223	30	26	1048	56	22	1869
5	40	263	31	28	1076	57	26	1895
6	38	301	32	28	1104	58	27	1922
7	39	340	33	24	1128	59	30	1952
8	38	378	34	24	1152	60	28	1980
9	36	414	35	50	1202	61	26	2006
10	34	448	36	41	1243	62	26	2032
11	33	481	37	39	1282	63	26	2058
12	30	511	38	38	1320	64	28	2086
13	30	541	39	34	1354	65	26	2112
14	28	569	40	32	1386	66	26	2138
15	30	599	41	32	1418	67	34	2172
16	28	627	42	28	1446	68	33	2205
17	26	653	43	32	1478	69	31	2236
18	32	685	44	42	1520	70	28	2264
19	38	723	45	37	1557	71	28	2292
20	24	747	46	28	1585	72	27	2319
21	23	770	47	35	1620	73	26	2345
22	35	805	48	36	1656	74	31	2376
23	33	838	49	30	1686	75	28	2404
24	31	869	50	28	1714	76	26	2430
25	38	907	51	30	1744	77	24	2454

Number of Course in Ascending	Height of Erch Course in Inches, Roughly	Whole Height from Basement, Ascending	Number of Course in Ascending	Height of Each Course in Inches, Roughly	Whole Height from Basement, Ascending	Number of Course in Ascending	Height of Each Course in Inches, Roughly	Whole Height from Basement, Ascending
78	24	2478	110	24	3359	142	22	4144
79	24	2502	111	24	3383	143	22	4166
80	22	2524	112	24	3407	144	28	4194
81	24	2548	113	23	3430	145	27	4221
82	24	2572	114	23	3453	146	24	4245
83	26	2598	115	23	3476	147	22	4267
84	26	2624	116	25	3501	148	22	4289
85	25	2649	117	23	3524	149	21	4310
86	25	2674	118	35	3559	150	26	4336
87	24	2698	119	31	3590	151	26	4362
88	24	2722	120	29	3619	152	25	4387
89	25	2747	121	28	3647	153	22	4409
90	36	2783	122	26	3673	154	21	4430
91	33	2816	123	26	3699	155	21	4451
92	31	2847	124	24	3723	156	21	4472
93	28	2875	125	24	3747	157	21	4493
94	26	2901	126	23	3770	158	21	4514
95	25	2926	127	23	3793	159	22	4536
96	24	2950	128	23	3816	160	21	4557
97	24	2974	129	23	3839	161	21	4578
98	41	3015	130	27	3866	162	24	4602
99	37	3052	131	25	3891	163	23	4625
100	34	3086	132	23	3914	164	25	4650
101	32	3118	133	22	3936	165	22	4672
102	30	3148	134	22	3958	166	22	4694
103	28	3176	135	22	3980	167	21	4715
104	27	3203	136	25	4005	168	21	4736
105	27	3230	137	23	4028	169	20	4756
106	26	3256	138	25	4053	170	21	4777
107	25	3281	139	25	4078	171	20	4797
108	29	3310	140	22	4100	172	21	4818
109	25	3335	141	22	4122	173	21	4839

Number of Course in Ascending	Height of Each Course in Inches, Roughly	Whole Height from Basement, Ascending	Number of Course in Ascending	Height of Each Course in Inches, Roughly	Whole Height from Basement, Ascending	Number of Course in Ascending	Height of Each Course in Inches, Roughly	Whole Height from Basement, Ascending
174	20	4859	189	21	5185	204	*21	5507
175	21	4880	190	21	5206	205	*21	5528
176	20	4900	191	21	5227	206	*21	5549
177	20	4920	192	21	5248	207	*21	5570
178	21	4941	193	20	5268	208	*21	5591
179	20	4961	194	21	5289	209	*22	5613
180	26	4987	195	22	5311	210	*24	5637
181	25	5012	196	24	5335	†211	*22	5659
182	23	5035	197	22	5357	212	*22	5681
183	24	5059	198	22	5379	213	*22	5703
184	22	5081	199	22	5401	214	*22	5725
185	21	5102	200	22	5423	215	*22	5747
186	21	5123	201	22	5445	216	*21	5768
187	20	5143	202	*21	5466	217	*20	5788
188	21	5164	203	*20	5486	218	*25	5813

* Estimated. † Number of courses estimated by Prof. Smyth.

Supposed complete number of courses, including the original topmost corner-stone, 218; whole height, 5,813 Pyramid inches, or 484 feet 5 inches (or 486 English feet).

NOTE: — We think Prof. Smyth erred in placing his first layer of stone (in his table of "Masonry Courses") opposite "Course" (marked) number 2. And again, in placing (his estimate) 211 for the complete number of courses of Masonry in the Great Pyramid, when it was complete with 30.6 feet greater elevation. For if so, each course now displaced must have averaged 36.8 inches in thickness, which would seem to be inconsistent from the average thickness of the last 100 layers that precede it.

THE SOURCE OF MEASURES.

PART II.

By J. Ralston Skinner, Cincinnati, Ohio, 1875.

(Sec. 22.) The following copious notes from the "Source of Measures" are by permission of the author when he lived:

"The following, in place of a work, strictly speaking, is rather an essay or study. It is like the study of an artist, where it comprehends many details in outline going to make up a whole, yet unfinished and subject to change, here and there as the blending of details may prove inharmonious or incongruous to the general scope of the design. Unlike such a study, however, others can join in the labor of completing the task; and it is hoped that it may prove an incentive to that end.

"The whole constitutes a series of developments, based upon the use of geometrical elements, giving expression in a numerical value. These elements are found in the work of the late John A. Parker, of the City of New York, setting forth *his* discovery (but in fact, the re-discovery) of *a* quadrature value of the circle. Upon this one, that of Peter Metius, of the sixteenth century, seems to be a variation.

"Mr. Parker makes use of an element of measure of the equilateral triangle, by which, as a *least unit* of measure, to express the measure of the elements of a circle in terms of the numerical value of a square: so that, as a conclusion, a square of 81 to the side, or 6561 in area, shall contain a circle whose area equals 5153; or, rectifying the circumference, a diameter of 6561 shall have a circumference of $5153 \times 4 = 20612$.

"Let it be understood that the question of value of that quadrature, whether by Mr. Parker, or by Metius, as to whether it is the expression of exactitude of relation, does not arise; nor is it, save incidentally, pertinent to the subject matter in hand. While this work thus is relieved of any necessity of examination into the question of the possibility of what is called '*the quadrature*' or '*the squaring of the circle*,' nevertheless, it is necessary to a proper understanding of the whole that some, to many persons very dry, details of Mr. Parker's construction of his quadrature should be set forth in the very commencement. Incidentally, however, it is thought that the matters established herein, as having a direct relation to the *holy things of God, as laid down in Scripture*, will force an inquiry on the part of devout people, into the abstract question of '*the quadrature*,' both as received and as set forth by Parker and by Metius; and also into the very question of any special value of the quadrature by Parker, as related to the generally accepted one.

"One development is as follows: The numerical value 20,612 of a circumference is made use of to derive from it a *unit of measure* for *linear*, *superficial*, and *solid* measure. Thus, as a common unit of measure is the edge of one of the faces of a cube, and as there are 12 edges to the cube, the division of 20,612 by 12 is the distribution of this value onto these 12 edges; so that the quotient, which is 1717.66+, is that unit of measure which is, however it may be used, convertible into circular, and again, back into the geometrical elements whence derived. And this is obtained by the special numerical value, 1717.66+the one-twelfth of 20,612, whether, as a fact, it be used as a whole or as a part, as 1.71766+. Now as a fact, 1.71766+ of the *British foot* is the ancient *cubit value*; hence, the whole scheme thus far displayed has been practically utilized, inasmuch as 20,612 is thus seen to be the value of British inches, while its derivative of 171766+, so divided or scaled as to represent 1.71766+, is the ancient cubit.

"This is confirmed from the fact of restoration, by means of these numerical values, of the Great Pyramid of Egypt, in terms of the British measures thereof made of late years. Another development is that, by a variation of the use of these numerical values, taken systematically, not empirically, a diameter value to a circumference value of 6 is found, which is discovered to be the basis of the Hindu method for the calculation of tables of *sines* and *cosines*, tangents and cotangents, and the orbits of planetary bodies; which variation, as an enlargement of the above values, on application, is found to give the exactitude of the pyramid measures, agreeably to the design of the architect, thus again coupling a modern with an ancient use.

"Another development is that the British system of *long* and *land* measures is discovered to contain an occult or obscure system of time calculations, based on the factor 6, by which it is seen that the entirety of the British measures rests upon these anciently developed elements, and thus it is in fact, but a phase of the Hindu system. The factor 6 is the basis of the *acre* and *mile* measure, running up from the inch and foot, and the equivalent of the base side of the pyramid (which is a diameter value to a circumference of 24) is the side of a square, divided into four equal parts of 6 x 6 each, in terms of the British foot, and necessarily the inch; hence the advanced measures as far as the mile, are thus involved. But while this is so, the means of obtaining this pyramid measure is through use of the Parker elements; hence the Parker elements are thus connected with the whole range of British measures.

"But the greatest development is that the entire system seems to have been anciently regarded as one resting in nature, and one which was adopted by nature or God, as the *basis* or *law* of the exertion practically of creative power —*i. e.*, it was the *creative design*, of which creation was practically the application. This seems to be established by the fact that, under the system set forth, measures of *planetary times* serve co-ordinately as measures of the *size* of planets, and the peculiarity of their shapes—*i. e.*, in the extension of their equatorial and polar diameters, in terms of the British measures, or the cubit measures arising as stated, from the forms of Mr. Parker. The true study of the Deity by man being in the observation of his works, the discovery of a fundamental *creative law* (in numbers and measures) as regards His works, of as wide and comprehensive grasp as shown, would locate the substance of such a discovery as the practical real tangible link between God and man, as that by which man can in a measure realize the actually existing working qualities of God, just, speaking most reverentially, as he would those of a fellow-man—as, say, of a mason, or of a carpenter; thus revealing tangible existence, likeness, relationship, and, remotely, companionship. Such a link, once found, would constitute a base for superstructures of recognition, praise, worship, and copy. As a fact, this system seems to underlie the whole Biblical structure, as a foundation for its ritualism, and for its display of the works of the Deity in the way of *architecture*, by use of the sacred unit of measure in the Garden of Eden, the Ark of Noah, the Tabernacle, and the Temple of Solomon.

"Such seem to be the characteristics of development from the elements of quadrature of the late Mr. Parker. The extent to which the development is made so as to compel a mental assent, must be tested, of course, through the contents of this work. There is no disposition on the part of the author to make any assertion as to the strength of his work. What he has done has been done to the best of his ability, and he believes that a studious careful reading of the work done, will be that, and alone that, upon which any fair criticism can be based. Since, after all, all matters of science subordinate themselves to anyone by which man can arrive at a realizable knowledge of God, all things in this book are of poor value in every other regard, comparatively, save as they lead up just to this kind or condition of knowledge. Such being the case the following statements may be made as *introductory*.

"(1.) The '*Quadrature of the Circle*,' by John A. Parker sets forth the integral relation of diameter to circumference of a circle as 6561 to 20612, derived from area computations, *viz.*: area of square being 6561, area of inscribed circle is 5153; and diameter being 6561, rectification of circumference is $5153 \times 4 = 20612$.

"(2.) It appears that nature was regarded as making use of this numerical relation, as a law or application of numbers to measures, by which to construct the mechanical properties of the universe; so regulating the times of the planets that they should move by a numerical system such that by the measure of their shapes was to be obtained in a definite class or scale of mesures adapted to the same system: so that movement should co-ordinate with size under the same system.

"(3.) However man obtained knowledge of the practicle measure, *the British inch*, by which nature was thought to adjust the planets in size to harmonize with the notation of their movements, it seems he did obtain it, and esteemed its possession as the means of his realization of the Deity—that is, he approached so nearly to a conception of a Being having a mind like his own, only infinitely more powerful, as to be able to realize *a law of creation* established by that being, which must have existed prior to any creation (kabbalistically called the Word). The knowledge thus gained was simply that of the measure spoken of with its uses, in connection with the geometrical elements from whence it sprang.

"(4.) This knowledge as to its origin, interpretation, and use, became somehow that of a *caste* condition. As such it was most sedulously concealed, and when set forth it was only in a secret or very obscure way. One way of setting it forth was by *hieroglyphic writing*. This method is the burden of the Hebrew Bible. Another was by *architectural display*. The greatest ever made was in the Great Pyramid of Egypt; the next greatest seems to have been in the Temple of Solomon.

"(5.) It is thought the restoration of this pyramid agreeably to the design of the architect, will afford the means of translation of the hieroglyphic meanings of the

Hebrew Bible, as, on hypothesis, the one was written and the other built to set forth the same natural problems.

"The first step, therefore, necessary to the deciphering of the hieroglyphic or symbolic meanings of the Hebrew Bible, is the restoration of the Great Pyramid after its architectural conception. This is the chief burden of this work, and it is thought that the intent of the architect has been so far recovered as to justify publication. Secondarily, it is to be shown that the Temple was but another architectural style of setting forth the same measures with the pyramid. The balance of the matters, condensed as much as possible into brief outline, chiefly serves to exemplify the method of Biblical application of the pyramid system. This balance is noted here and there in the text, and is contained in the appendices. It serves to relieve the dry details of figures and calculations, to show related connections, and is hoped to excite interest in the whole subject, and to stimulate those who may read, to an earnest effort in the further prosecution of this subject so fascinating in its elucidations."

The relation of 6561 : 20612 is both in the pyramid structure and in the Bible coupled with the form 113 : 355. Some connections between the two will be shown, but what the exact basis relations between them were, as anciently recognized, remains to be discovered.

THE HEBREW ALPHABET.

(Sec. 23.) For the general reader to understand how a numerical or mathematical system may lie closed up in the Hebrew Bible, it may be well to state that the Hebrews, so far as has come down to us, have no numerical system apart from their literal one—*i. e.*, their alphabet held their numerals, just as if, in English, our a, b, c, stood for 1, 2, 3, and so on, in lack of the Arabic system of numerals, borrowed by us, and now of exclusive use (although it would seem that they were in possession of this system also). The following is a table for reference, giving the Hebrew alphabet, the power of the letters, their symbols to some extent, with the numerical value fixed to each letter. The laws of symbolic use of words as numbers in the narrative of the Bible are not known, and the real uses are only to be accepted or received to the extent for which there is intrinsic proof. Otherwise, it is to be observed that where the letter values rise above units to tens and to hundreds while the letter character may stand for, say, 20 or 200, very frequently the *characteristic* value is used as giving the expression of the unit value of 2 alone. These subjects can be but touched on in this work. It must suffice to close with the alphabet table (English pronunciation) without the characters.

NO.	NAME.	FORM AND POWER.	SYMBOL.
1.	Aleph.	A scarcely audible breathing.	Ox or Bull
2.	Beth.	*b*, *bh*, or *bv*.	House.
3.	Gi′ mel	*g*, *gh*.	Camel serpent erect.
4.	Da′ leth.	*d*, *dh*.	Door, *hinge?*
5.	He.	*h*; Latin *e*.	Window opening, womb (Kabbala)
6.	Vau.	*v* or *w*.	Nail, hook, crook.
7.	Zayin.	*z*.	Weapon, scepter.
8.	Cheth.	*ch*, *kh*, *hh* Latin *h;* rough breathing.	Fence, Venus. Affinity with He, as the womb.
9.	Teth.	*t*.	Snake, basket, figured in Eleusinian mysteries in worship by women. Love apples, etc.
10.	Yodh.	*y*, *i*, or *j*.	Hand, bent forefinger, *membrum virile* with testes. The perfect number, or *one*.

NO.	NAME.	FORM AND POWER.	SYMBOL.
20.	Caph.	*c*, *ch*, *k*, *kh*	The hollow of the bent hand; measure of hollow sphere.
30.	La′ medh.	*l.*	Ox-goad; sign of a form of the god Mars.
40.	Mem.	*m.*	Water.
50.	Nun.	*n.*	Fish, symbol of *Yoni* O, woman, or womb.
60.	Sa′ mech.	*s.*	A prop, a pillar; testes, hence, egg. Divisions of the circle, perhaps indicating a square. Divisions of Paradise.
70.	Ayin	no power	Eye.
80.	Pe.	*p*, *ph.*	Mouth.
90.	Tṣa′-dhe	*ts*, *tz.*	Fish-hook, hunter's dart.
100.	Koph.	*k.*	Back of head from the ears; hence significent of *balances.* Ancient pillow to rest the back of the head on. Skull? Eye of needle.
200.	Resh.	*r.*	Head, sphere, circle.
300.	Shin, Sin.	*sh*, *s.*	Tooth.
400.	Tau.	*t*, *th.*	Cross, + Foundation framework of construction.

QUADRATURE OF THE CIRCLE.

BY JOHN A. PARKER.

(Sec. 24.) Kabbala was a species of symbolic writing among the initiated, setting forth the secret teachings of the Bible; and a key of Kabbala is thought to be in the geometrical relation of the area of the circle inscribed in the square, or of the cube to the sphere, giving rise to the relation of diameter to circumference of a circle, with the numerical value of this relation expressed in integrals. The relation of diameter to circumference being a supreme one connected with the god-names Elohim and Jehova (which terms are expressions numerically of these relations, respectively—the first being of circumference, the latter of diameter), embraces all other subordinations under it. Two expressions of circumference to diameter in integrals are used in the Bible: (1.) The perfect; and, (2.) The imperfect. One of the relations between these is such that (2) substracted from (1) will leave a unit of diameter value in terms, or in the denomination, of the circumference value of the perfect circle, or a unit straight line having a perfect circular value, or a factor of circular value.

Of course as to the fact of these expressions residing in the Bible, it remains to be seen whether this is, or is not, so. It will be sufficient if it is so; but if it shall so appear, beyond contradiction, it will afford much food for thought, as to whether so sublime a work as the Holy Record *can be* a refuge for that much oppressed and bedeviled idea "*squaring the circle*," unless the actuality of such relation exists, or unless an approximate of a certain nature and value was found to be of some natural use.

(Sec. 25.) It is very remarkable: One of the values thus used in the Bible was rediscovered in about A. D. 1585, by Peter Metius, as 113 for diameter to 355 circumference, which, in the sacred record, is the imperfect value; the other was rediscovered by the late John A. Parker, of the City of New York, 6561 for diameter to 20612 for circumference, which, in the Sacred Record, is the perfect value. What the means of discovery by Metius were, is not known. The "*Quadrature*" of Mr. Parker is in print, and therein the steps are fully set forth. As to these, as they contain the geometrical key for the proper understanding of Kabbala, it is necessary to set them forth somewhat at large, premising that his value is obtained through the value of *areas of shapes*. His leading propositions (each proposition, in the text being followed by its demonstration are as follows:

Proposition I. "One of the relative properties between straight lines and a perfect curve or circle is such that all regular shapes formed of straight lines and equal sides, have their areas equal to half the circumference multiplied by the least radius which the shape contains (which is always the radius of an inscribed circle), than which every other radius contained in the shape is greater, and the circle has its area equal to half the circumference multiplied by the radius, to which every other radius contained in the circle is equal."

Proposition II. "The circumference of any circle being given, if that circumference be brought into the form of a square, the area of that square is equal to the area of another circle, the circumscribed square of which is equal in area to the area of the circle whose circumference is first given."

Proposition III. "The circle is the natural basis or beginning of all area, and the square being made so in mathematical science, is artificial and arbitrary."

Proposition IV. "The circumference of any circle being given, if that circumference be brought into any other shape formed of straight lines and of equal sides and angles, the area of that shape is equal to the area of another circle, which circle being circumscribed by another and similar shape, the area of such shape circumscribing the last-named circle is equal to the area of the circle whose circumference is given."

PROPOSITION V. "The circumference of a circle by the measure of which the circle and the square are made equal, and by which the properties of straight lines and curved lines are made equal, is a line outside of the circle wholly circumscribing it, and thoroughly inclosing the whole area of the circle, and hence, whether it shall have breadth or not, forms no part of the circle."

PROPOSITION VI. "The circumference of a circle, such that its half being multiplied by radius, to which all other radii aré equal, shall express the whole area of the circle, by the properties of straight lines, is greater in value in the sixth decimal place of figures than the same circumference in any polygon of 6144 sides, and greater also than the approximation of geometers at the same decimal place in any line of figures."

Under this proposition after his demonstration, he states: "And it is evident that if a circle, and a polygon of 6144 sides (the number to which Playfair carries his bisection), shall have the same circumference, the area of the circle is greater than the area of the polygon in the sixth decimal place; and because the circumference of one diameter must be four times the area of the circle, therefore, by the transition of shape to a circle, the true value of circumference is greater in the sixth place than any approximation which can be obtained from a polygon of 6144 sides, whether inscribed or circumscribed."

PROPOSITION VII. "Because the circle is the primary shape in nature, and hence the basis of area; and because the circle is measured by, and is equal to the square only in ratio of half its circumference by the radius, therefore, circumference and radius, and not the square of diameter, are the only natural and legitimate elements of area, by which all regular shapes are made equal to the square and equal to the circle."

PROPOSITION VIII. "The equilateral triangle is the primary of all shapes in nature formed of straight lines, and of equal sides and angles, and it has the least radius, the least area, and the greatest circumference of any possible shape of equal sides and angles."

PROPOSITION IX. "The circle and the equilateral triangle are opposite to one another in all the elements of their construction, and hence the fractional diameter of one circle, which is equal to the diameter of one square, is in the opposite duplicate ratio to the diameter of an equilateral triangle whose area is one.

"By diameter of the triangle, the perpendicular is here meant, as explained in the introduction to Section I., or a line passing through the center of the triangle, and perpendicular to either side.

"Let it be supposed that the areas of the equilateral triangle A and the square C each equals *one*.

"It has been shown (Proposition VIII.) that the triangle has the least number of sides of any possible shape in nature formed of straight lines; and the circle is the ultimatum of nature in extension of the number of sides. In this particular, therefore, they are opposite to one another in the elements of their construction. By Proposition

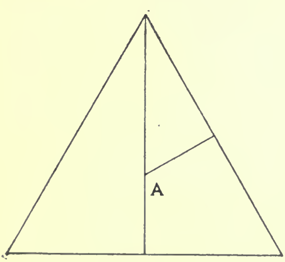


PLATE I

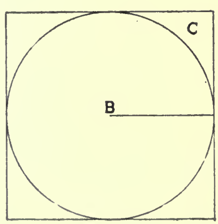


PLATE II.

VII., it is shown that circumference and radius are the only natural and legitimate elements of area by which different shapes may be measured alike, and are made equal to one another. By Proposition VIII., it is shown that the triangle has the *least* radius of any shape formed of straight lines of equal sides and of the same circumference, and by Propositions II. and IV, Section I., it is seen that the circle has the *greatest* radius of any possible shape of the same circumference. By the same propositions, the triangle is shown to have the *greatest* circumference and the *least* area of any shape formed of straight lines and equal sides, and the circle is shown to have the *least* circumference and the *greatest* area of any shape. By a well known law of numbers and geometry, by which the greatest product which any number or any line can give, is, to multiply half by half, it will be seen that if we take the aggregate of circumference and radius in each shape, it is most *equally* divided in the circle, and the most *unequally* divided in the triangle of any possible shape. In *every* case, that which is *greatest* in the triangle is *least* in the circle, and that which is least in the triangle is *greatest* in the circle; and in every particular the two shapes are at the extreme and *opposite boundaries of nature*, being the *greatest* and the *least* that is *possible*. They are, therefore, opposite to one another in all the elements of their construction. Therefore, the square being made the artificial basis of area (Proposition VII.), if the diameter of the circle B (Plate II.) shall equal the diameter of the square C, then, in the fraactional relations of B and C such diameter shall be in the opposite duplicate ratio to the diameter of A correspondingly situated. The diameter of A correspondingly situated with the diameter of B to C, it will be seen, is a line drawn across the center of A perpendicular to either side; therefore, the diameter of B, in its fractional relation to C, is the opposite duplicate ratio to the *perpendicular* or diameter of A, and no other result is possible in the nature of things. *The proposition is therefore demonstrated.*"

Proposition X. "The fractional diameter of one circle which is equal to the diameter of one square, being in the opposite ratio to the diameter of the equilateral triangle whose area is one, equals 81.

"Let the area of the equilateral triangle A (Plate III) equal one, and let the area of the square B (Plate IV) also equal *one*, then the diameter of the circle C, which is equal

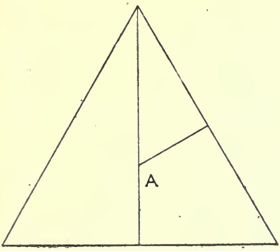


PLATE III.

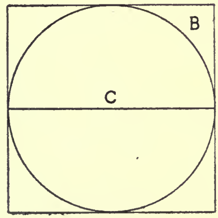


PLATE IV.

to the diameter of the square B, also equals *one*. And it has been demonstrated that in their fractional relations to the square, the diameter of A and C are in opposite ratio to one another. By the diameter in the triangle it is known that the perpendicular is here meant (as in Proposition IX). Now if the area of the equilateral triangle A shall equal one, then the diameter of A is found to be equal to the square root of three twice extracted, or $\sqrt{\sqrt{3}}$. Hence the fractional diameter of C, being in the opposite duplicate ratio (which is the squares of diameter), shall equal three twice squared, or $3^2 \times 3^2$, and $3 \times 3 = 9$, and $9 \times 9 = 81$. The proposition is therefore demonstrated."

The opposite duplicate ratio of Mr. Parker has relation to the numerical values. The shapes being opposite to each other, he desires to get an *integral* number to coordinate with the shapes. When the area of $A = 1$, then the diameter is found to be $1.316074+$. But this will not do, for, if possible, it must assume the form of a least integral number. Square this value, and it equals $1.7320508+$. This will not do. Square it again, however, and it equals three, which is just that to be desired. Having, however, obtained this, the value in the opposite ratio must suffer the same process, and $3^2 = 9$, and $9^2 = 81$.

PROPOSITION XI. "The fractional area of one square, which is equal to the area of one circle, equals 6561; and the area of the circle inscribed in one square equals 5153."

"It has been proved (Proposition X.) that the fractional diameter of the circle C, which is equal to the diameter of one square (B), whose area is one, being in the opposite ratio to *a b* (Fig. 8), equals 81; hence the area of B equals 81 x 81 = 6561; therefore, B equals one of 6561 equal fractional parts. Now let B equal H in area. It has been proved (Proposition II) that H equals E in area; and if H = 1, then E = 1; and if H = 6561, then E = 6561. It has also been proved (Proposition II) that if the circumference of F equals the circumference of E, then F and G are also equal in area. And because one circle which is equal to one square (the area of the square being one), is in 6561 equal fractional parts, therefore, *any* circle which is equal to *any square* (the diameter of the circle being a whole number) shall be in some definite and certain number of 6561 parts. Hence the areas of the circles C and G (their diameters being each 81) are some definite and certain

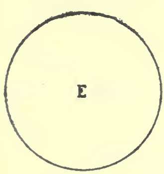


FIG. 5.

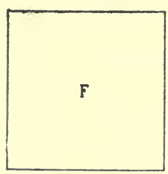


FIG. 6

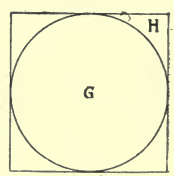


FIG. 7.

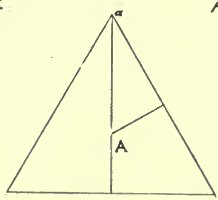


FIG. 8.

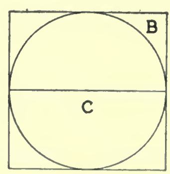


FIG. 9.

number of 6561 parts of B and H. It is proved by the approximations of geometry, obtained by the properties of straight lines, that C and G are each greater (much greater) than $\frac{5152}{6561}$ parts of B and H, and less (much less) than $\frac{5154}{6561}$; therefore (*Reductio ad absurdum*) they *shall* be each $\frac{5153}{6561}$ because they *can be nothing else*, there being no other 6561 part between 5152 and 5154.

"The proposition is therefore demonstrated; and the fractional area of one square, which is equal to one circle (the area of each being one), is 6561, and the fractional area of one circle inscribed in such square is 5153."

The expression, "It is proved by the approximations of geometry obtained by the properties of straight lines," contains a very subtle allusion and meaning. Mr. Parker approves the approximate value, as obtained by Playfair, after the method of its obtainment, *viz.*, by the properties of straight lines, where such lines are defined as being without *breadth* or *thickness*. Assuming the property of breadth to a line or unit of measure, or obtaining the value of it by means of *area computation*, works a change on the Playfair result necessarily. Now if Mr. Parker is correct in his taken relation between triangle and circle to obtain a least integral unit of measure—*i. e.*, the number 3—then, without at all conflicting with the Playfair results, his own are right if Playfair's are so.

PROPOSITION XII. "The true ratio of circumference to diameter of all circles is four times the area of one inscribed in one square for the ratio of circumference, to the area of the circumscribed square for the ratio of diameter. And hence the true and primary ratio of circumference to diameter of all circles is 20612 parts of circumference to 6561 parts of diameter."

"It will be known that if the diameter of the circle G inscribed in H = 1, then the area of H also = 1. It will be known also, that the area of G equals half the circumference multiplied by half the diameter, and $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$; hence, the diameter of G being *one*, then the area of G equals $\frac{1}{4}$ its circumference, and, *vice versa*, the circumference of G equals four times its area. And the diameter of G being one, it therefore equals the area of H, because the area of $H = 1$. Therefore, the first part of the proposition is demonstrated, four times the area of any inscribed circle for a ratio of circumference, to the area of the circumscribed square for a ratio of diameter, is seen to be a true ratio of circumference to diameter of *all circles*.

"It has been proved (Proposition XI) that the primary relations existing between straight lines and curved lines as developed by the opposite ratio of the equilateral triangle and the circle, the fractional area of $H = 6561$, and the area of $G = 5153$; *therefore*, the true and primary ratio of circumference to diameter of all circles $= 4G$, for the ratio of circumference to the area of H for the ratio of diameter; and since $G = 5153$, and $H = 6561$, *therefore* the *true* and *primary* ratio of circumference to diameter of all circles $= 5153 \times 4 = 20612$ parts of circumference to 6561 parts of diameter."

"The proposition is therefore demonstrated, and the quadrature of the circle is demonstrated," Mr. Parker should have added, to be explicit, and exceptional to the Playfair method, "by way of area computation."

QUADRATURE.

By Peter Metius.

(Sec. 26.) Some years ago while examining into the reasoning of Mr. Parker, the author found notice of the ratio of *Metius*. He wrote Mr. Parker, asking him if he was acquainted with the grounds on which Metius obtained it. He replied that he was not; but, upon testing the ratio sent, by his own, he found some very curious numerical relations of difference. Subsequently, in a proposed second edition of his work (published after his death) he notices this ratio and these relations as follows:

"The ratio of Metius, known for more than a century past (113 to 355), is the nearest approximation to the truth ever made in whole numbers, but it does not answer the imperative law contained in our twelfth proposition, and therefore it cannot be true. *The circumference cannot be divided by four, without a fraction or remainder.* By whatever means Metius may have obtained his ratio, its examination shows it to be of *the same composition as mine, but improperly divided.* For example, if 113 shall be the diameter of a circle, then circumference (355) is 1-20612 part too little. But if 355 shall be the circumference of a circle, then diameter (113) is 1-6561 too big. It thus affords a very perfect evidence that my ratio 20612 to 6561 is the true one, as we have fully proved it to be."

The conclusion thus drawn does not seem to be so manifest as stated. The relation between the two ratios is, however, very, yes, exceedingly remarkable, as the statement will show:

$$20612 : 355 :: 6561 : 112 \frac{20611}{20612}.$$

$$6561 : 113 :: 20612 : 355 \frac{1}{6561}$$

(Mr. Parker has confused the results.) The relation seems to be one which has, at some time, been found as a variant on the Parker forms, because of showing the same composition, as he says. The reverse of the case will not hold; for, if the Parker forms be tested by those of Metius no similar relation will be found to exist; therefore it would seem that those of Metius were derived from those of Mr. Parker.

REFLECTIONS ON THE QUADRATURE.

BY MR. PARKER.

(Sec. 27.) It is averred that the quadrature by Mr. Parker is of great value. It is not, however, because of the intrinsic value of his work that it is so largely set forth;

nor is it from any immediate motive to advocate or sustain it. It is (1) because his can be shown to be that identical measure which was used anciently, as the perfect measure, in the construction of the Great Pyramid, which was built to *monument it and its uses*; (2) because, from it, the *sacred cubit value was derived*, which was the cubit value used in construction of the Temple of Solomon, the Ark of Noah, and the Ark of the Covenant—the value of all which consisted in the value of the measures used; (3) because it affords that *Kabbalistic value* which before all others, conveys in the Bible the idea of God, the meaning of the term, and the values of his works in the Cosmos; (4) because the geometrical symbols out of which it is seen to spring, with their primary numbers, are seen to have a kind of *elemental relation to each other*, and were made use of in the mysteries to convey the esoteric teachings; and finally, (5) because it appears bound up in, and as making a fundamental part of the English system of *long and land and time* measures. If these statements are true, there will admittedly be no use to assert that it is well worthy of being set forth. All who appreciate the intense labor of research for light upon these matters will attach a value to this work of Mr. Parker far beyond that of the standard method, even though it should be defective, because its value will consist in its being *a literary key* such as has never yet, it is thought, rewarded the generations upon generations of searchers in the Bible, in mythology, and in the antiquarian fields. In this view, the question simply of its mathematical value is one of the least possible importance *as a primary one*; although once recognized to have been used as stated, there is no doubt but that it would cause the foundations of the standard methods to be reviewed with an intensity of thought, which might, perhaps, in the end, establish Mr. Parker's method as the one giving a more useful result—*i.e.*, perhaps, such an integral one, in area computation, as could be followed or copied after in material construction; albeit, it might, just as the Playfair method, be, after all, but an approximation. With this apology it may be well to suggest some thoughts in relation to this quadrature value, which, to some extent, are worthy of attention, and, to some extent are curious.

MR. PARKER'S QUADRATURE VALUES OBTAINED BY AREA COMPUTATIONS.

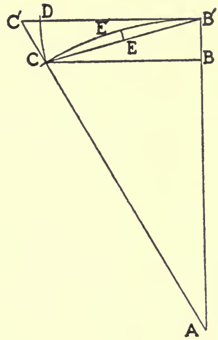
(Sec. 28.) It seems to be of importance, and it will be observed, that, from beginning to end, Mr. Parker seeks the quadrature through area measure, in terms of area, and finally obtains his numerical value of rectification by an area computation. His numerical values are all area values to correspond with his geometrical figures; and even so in this final value, for it is in area terms where it exhibits a necessary value of linear measure of circumference. This being the case, it is evident that his computations are susceptible of material realizations, as in object building or copying. If his process is correct, then, under his Proposition XI., he has raised a test by which to work a change on the standard method to make it conform to area conditions and requirements. The fact that independently he has reproduced exactly the same formulæ which the ancients had, which formulæ had with them application to the same end, viz., relation of diameter to circumference, goes far to prove that *his steps* of ascertainment must have been the same as with them, though they may have had other and more satisfactory methods of illustrating and enforcing the result. His process seems to depend for its correctness upon the rightness of his ground of the opposite qualities of the triangle and circle. If this is rightly taken, his numerical integral relation founded on the number 3 must be right. His final step for obtaining the area 5153 of the inscribed circle depends upon the question whether the *Legendre, or Playfair approximate*, is right as a transcendental one.

CURIOUS FEATURES OBSERVABLE IN THE DETAILS OF THE PLAYFAIR METHOD.

(Sec. 29.) It must be known that the results as to the value of *pi*, by Legendre and Playfair, were not of universal acceptation. They were, for instance, criticised as being incorrect, by Torelli, in the preface of an edition of the works of Archimedes, printed at Oxford. Reference is made to this preface, and also to Playfair's comments on the same, as they are to be found in the supplement to Playfair's Euclid. Torelli held, according to Playfair:

"That it is impossible, from the relation which the rectilineal figures inscribed in, and circumscribed about, a given curve have to one another, to conclude anything concerning the properties of the curvilineal space itself, except in certain circumstances, which he has not precisely described."

The following practical truths seem to the author to be exceedingly remarkable as looking, in this specialized way, toward the support of Torelli's assertion, though no assertion must be considered as made that it affects the truth of the general results of the Legendre method. The burden of the effort of Legendre is to show that by the growing diminution and equality between the circumscribed C′ B′ and the inscribed C B, the curved line penned up between them becomes measureable; which curved line at any stage of bisection, being an even and known part of the whole circle, from it the length of the entire circumference, and consequently the area of the curved space, is to be had. The measure of this growing equality is always to be tested by the difference of value, at any stage of bisection, between C B and C′ B′. In the diagram, which may stand for any stage of bisection C B′ is the chord of half the arc, and therefore E E′ is B B′ for every succeeding bisection. Now, from B′, as a center, with C B′ as a radius, describe the arc C D. Then C′ D will be the quantity which, vanishing by diminution, the triangle



C B′ C′ will eventually become C B′ D, and isosceles; when the curve lying between C B′ and D B′ *must*, by hypothesis, become equal to C B′, or to D B′, as a straight line. Now, as a fact, taking the value C′ D (the difference between C B and C′ B′) and E E′, for a number of bisections, and it will seem to show that, with relation to the diminution of C′ D, E E′ is increasing, and by an increasing ratio. It becomes a question, on the showing, whether the arc is not, *relatively*, separating from, instead of approaching the chord. If so, the question is, what is the effect of this? What does it mean? If E E′ is thus increasing, what is the value of the arc becoming?

Is there some incompatibility between the geometrical conditions, as presented to the eye and the numerical calculations of these forms? The rigid result of such a condition would seem to be that, the ratio increasing, the step would come where, as Mr. Parker avers, C B′ curve would necessarily pass in value beyond that of C′ B′ diminished—an absurd conclusion, unless some unnoticed incompatibility has existed between the condition of the curve and the calculations of the sides of the polygons. It is possible that this may be the case, since, in fact, the relations between them are not known, but only inferred. Practically, a calculation of the value of *pi* to 6144 sides of the polygons taken from the base that the perimeter of the polygon of six sides is *one* with twenty-five ciphers, making the radius one with 6 repeated twenty-four times, yields the following data as to the relation *or ratio* between C′ D and E E′, as they respectively diminish with continuing bisections of the arc:

6 sides,	C′ D	: E E′	:: 1 :	0.5706
12 sides,	C′ D	: E E′	:: 1 :	1.2404
24 sides,	C′ D	: E E′	:: 1 :	2.5301
48 sides,	C′ D	: E E′	:: 1 :	5.0847
96 sides,	C′ D	: E E′	:: 1 :	10.1818
192 sides,	C′ D	: E E′	:: 1 :	20.3697
384 sides,	C′ D	: E E′	:: 1 :	40.7426
768 sides,	C′ D	: E E′	:: 1 :	81.4882
1536 sides,	C′ D	: E E′	:: 1 :	162.9917

which shows a rapid ratio of diminution of C′ D with relation to that of E E′: and the practical diminution of C′ D may be judged from a statement of its value at 6 sides and 6144 sides, as follows:

6 sides, C′ B′=	962250448649
6 sides, C B′=	862730150341
C′ D, or difference=	99520298308
6144 sides, C′ B′=	000852211623
6144 sides, C B′=	000852211539
C′ D, or difference=	84

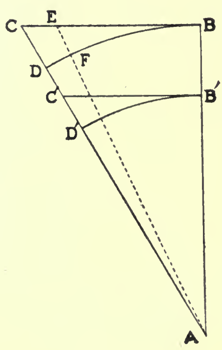
which simply seems to show that the triangle C B′ C′ is approaching to being isosceles unattended by a relatively rapid approximation of the chord C B′ to the curve C B′. But the relation of this approximation can be had by a statement of the continuing ratios between B B′ and E E′, and these are as follows:

E E′ for	6 sides	: B B′	:: 1 :	3.9318516
E E′ for	12 sides	: B B′	:: 1 :	3.9828897
E E′ for	24 sides	: B B′	:: 1 :	3.9989291
E E′ for	48 sides	: B B′	:: 1 :	3.9997322
E E′ for	96 sides	: B B′	:: 1 :	3.9999330
E E′ for	192 sides	: B B′	:: 1 :	3.9999832
E E′ for	384 sides	: B B′	:: 1 :	3.9999958
E E′ for	768 sides	: B B′	:: 1 :	3.9999989
E E′ for	1536 sides	: B B′	:: 1 :	3.9999997

Does not this simply show that while the ratio of E E′ to B B′ can never become 1 : 4, the ratio of C′ D to E E′ can become 1 : ∞ large? which mathematically expressed means that the triangle C B′ C′ may become isosceles, while yet, absurdly enough, the chord and arc have not as yet assimilated? Not only so, but have separated by a (relatively) infinite quantity.

MATHEMATICS (OR THE STATEMENTS OF MATHEMATICIANS) IS FAMILIAR WITH DEFINITIONS WHICH ARE UNTRUE.

(Sec. 30.) It is unfortunate for mathematics that, in attempting to set forth methods of comparative measures of right and curved lines, it has been found necessary to assume truths as the very groundwork of such measures, which, in fact, and in the nature of things, are not so. As to the Calculus, for instance, its results are taken as *exact*, when the differentials, which are real quantities belonging to those results, are eliminated; because, as it is said, on account of their smallness, they can afford to be dropped. The very inception of Newton's "*Principia*," for another instance, is founded upon a geometrically false statement, as regards exactitude of definition—palpably so. His "Lemma I." states: "*Quantities and the ratio of quantities, which in any finite time converge continually to equality, and, before that time, approach nearer the one to the other, than by any given difference, ultimately become equal.*" Let A B C be any triangle, and with the length A B as a radius, let the arc B D be drawn to intercept the line A C. Suppose this figure, both for triangle and segment of circle, be continually and proportionately reduced, as A B′ C′, A B′ D′; the *relative* differences will never be changed, and, consequently, the ratios of difference will always remain the same. The proposition is axiomatic, and does not require demonstration. But take the triangle A B C, with the circular area A B D, as decreasing toward A B, by different and



successive steps, one of which is, say, A B E, with the circular area A B F. By this method, no geometrical ratio can be preserved. The ratio of diminution has to be calculated by numerical combinations. But *there being* a ratio of diminution, in which the difference between the straight line and the curve is, say, a decreasing one, it is, nevertheless, plainly to be seen that the only equality of the curved line B D with the straight line B C, in any possible diminution, will be when the line A C shall so close upon A B as to wholly coincide with it (as to the value of their lengths now or at last becoming alike), and become, with A B, one and the same line, at which stage or condition there can be neither curved line nor straight left for comparison: therefore, so long as those lines, *i. e.*, C B straight, and B D curve, exist at all, either in whole or in part, there can, by possibility, be no equality between them. Hence the *lemma* is false in its terminology; nor is it even right in a showing of a growing or proximate equality, as regards the *ultimate structure* of the lines, as was shown above.

There is a certain ridiculousness in the matter, in this, that while the schools assert the impossibility of there being an integral relation between circle and square, because of the essential difference between a curved and a right line (which is true to all intents), the possibility of this integral relation is here, by inference, falsely set forth and maintained. It is *because* a line has breadth that a curved and straight line are not comparable. Straight and curved lines conceived of as without breadth may be taken as comparable, because of the possibility of their reduction to points.

NATURE SEEMS TO AFFORD CONFIRMATORY EVIDENCE THAT MR. PARKER IS RIGHT.

(Sec. 31.) Mr. Parker is of the opinion that there is in numbers some, so to speak, flux of notation of quantity, by which geometrical shapes can be integrally noted as changing the one into the other. Thus, if he is right, there is a unit square, which is of the denomination of $\frac{1}{6561}$ of a square area, while it is also at the same time of a denomination of a $\frac{1}{5153}$ of a circular area. Evidently, then, whatever rectuangular figure is represented in terms of this unit square, its equivalent circular area value in integrals can be given in the same terms; as $\frac{4}{6561}$ of a square $= \frac{4}{5153}$ of a circular area. It may be that nature assumes, in some of her practical constructions on the principals of plane and spherical geometry, a least cubit one; and it may be that it is in terms of this least one that she performs her works, *approximating* the form of a sphere by its use. It may be that Mr. Parker's method is right as a natural mechanical one, while that by Playfair may be right as a transcendental one. It is certain that nature does lend some data as touching some of her methods of construction. The condition of substance to form what is called *water*, is one resting upon the quality of *heat* as affecting atomic particles of matter. *Heat* being but a modification of *motion of particles*, a spheroid or drop of water is such because of its particles being in some peculiarity of motion on *themselves*, through perhaps the intervention of some subtler substance in which the atoms may act. Thus the globule, or spheroid, of water is formed. The effect of cessation of this motion is indicated by a cessation of spheroid shape. *Motion* giving place to *rest*, the change is characterized by change of *shape*; and this change seems uniformly to be that, as to shape of particles, of the equilateral triangle as part of a hexagon. On this form, other shapes take place. In one form, at and growing out of the corners of the hexagon, are little squares or cubes. (See description by Professor Tyndall of these forms, as becoming manifested in the breaking down of ice particles in the interior of a mass, when heat rays are passed through it.)

In this shape the substance has become *ice*. If chemically the components of water are in integral atoms, and if, in its structural form, in passing from shape to shape, it passes from one integral form to another, *as to shape*, this would serve as a strong hint that nature recognizes the alliance and interchanges of shapes in subdivisions of wholes not fractions. It is noteworthy that the primary *material one* here indicated in ice seems to be triangular or pyramidal than cubic; and this in a measure serves to strengthen Mr. Parker's assertations, for it is on the triangle as the natural originator of plane shapes that he raises a least integral in the number 3, by which to express the value of the circle in terms of the square and cube; and, again, he accomplishes this by an integral relation, so close to the Playfair transcendental one, that the difference only becomes manifested at the sixth decimal place, in a circumference taken to a diameter of unity.

PROBLEM OF THREE REVOLVING BODIES.

(Sec. 32.) It is thus seen that the process of Mr. Parker is founded geometrically upon the elements of the circle and of the equilateral triangle, being, as related to each other, the extreme opposites in nature, of which the circle is the primary of all shapes, and hence the basis of all area, and the triangle is the primary in nature of all shapes formed of straight lines, and of equal sides and angles. Of these the equilateral triangle is numerically measurable; and it being requisite to translate shapes by numbers, as to the conditions required by a least numerical integral value, with which to determine the value of the circle, that integral least number is found to be 3. By means of this shape and this integral he obtains the value of the circle, that shape of greatest extension as compared with the triangle, in terms of the square. Numerically, $\sqrt{\sqrt{3}}$ is opposed by $3^2 \times 3^2 = 81$ = diameter of his square, or the length of its side. $81^2 = 6561$ = area of his square, in terms of his least numerical integral. The area of the contained circle=5153; and, by the process set forth, changing area value to represent rectification, diameter being 6561, circumference=20612. The results, therefore, are:

(1) Area of square .... =6561
Area of contained circle...... =5153
(2) Diameter of circle .... =6561
Circumference of circle . . =5153x4 =20612

PROBLEM OF THREE REVOLVING BODIES.

By Mr. Parker.

(Sec. 33.) Mr. Parker follows up the ascertainment of these data with his problem of three revolving bodies, founded upon the principles of the quadrature. This problem is as follows:

Proposition I. "The respective and relative motion of three gravitating bodies revolving together and about each other is as four to three, or *one* and *one-third* of one primary circumference.

"I have always considered this proposition as self-evident on the face of it, and that no mathematician would deny it and hazard his reputation on sustaining the denial with proof. But as I shall perhaps be called upon for proof, I add here, at some length, the solution of the problem, after my own method as follows:

"The problem of three gravitating bodies revolving together and about each other is one which like the quadrature, has hitherto baffled all attempts of mathematicians to solve. But since this, like others of the kind, is of itself a problem, which is daily performed and consequently solved by the mechanical operations of nature, the failure of mathematicians to reach the solution proves nothing but the imperfection of the reasoning applied to it.

"It is a principle, I think, clearly demonstratable, that whatever can be constructed by mechanics out of given magnitudes, can be *exactly* determined by numbers, and that which cannot be constructed by mechanics out of any given magnitudes, cannot be exactly determined by numbers, having the same relation as the magnitudes one to another. It is for this reason, and for this reason only, that we can not, *out of the same magnitudes*, construct a square which is just twice as big as any other perfect square; neither can we find the perfect root of such a square by decimal numbers. If this reasoning be true, then, because the problem of three gravitating bodies is a mechanical operation daily performed in nature, it is hence a thing capable of being proved by numbers. The great difficulty of this problem has arisen, I think, from the impossibility of its full display by diagram, and the difficulty of embracing, in any formulæ, all the conditions contained in its elements. The plan of exacting a display by diagram of all the geometrical propositions is *safe*, and perhaps it is the only plan by which the yet untaught mind can be initiated into the truths of geometry; but is always necessary in every original demonstration? Are there not other means equally true and *equally safe* in the hands of one accustomed to examination, and acquainted with the properties of numbers and of shapes? I think there are; and without taking the least unwarrantable latitude, or departing from the clearest perceptions of reason, I think this problem may be easily and accurately solved.

"The thing required of every demonstration is, that it shall give a *sufficient reason* for the truth which it asserts. But, in order that a reason may be *sufficient*, and the conclusion drawn from it *safe*, it is necessary, not only that the relations of cause and effect shall be made clear to our perceptions, but also that the conclusion, *when drawn*, shall abide the test of practical application. Any demonstration which does less than this cannot be relied on, and no demonstration ever made has ever done more than this.

"We know very well that things are possible or impossible to be done, only in proportion as the means applied are adequate or inadequate to the purpose. We know also that because different principles exist in the various forms of matter, therefore it is impossible to demonstrate everything by the *same means* or *same principles*. It is a narrow minded prejud ce, therefore, which exacts that every demonstration shall be made by the prescribed rules of science, as if science already embraced every principle which exists in nature. Yet none are more frequently guilty of this narrow-mindedness than mathematicians, who often require that things shall be done by the means which the written science affords, well knowing at the same time that such means are *inadequate*. Such has always been the case in respect to the quadrature of the circle. Mathematicians have demanded that it should be demonstrated by the properties of straight lines, knowing at the same time that straight lines are *inadequate*. Therefore (*and therefore only*) the thing has been found impossible, and all other demonstrations are rejected, because they cannot be shown by straight lines. I do not consent to such unreasonableness of decision; but, in every proposition where the *sufficient reason* is manifest, I hold the proposition to be demonstrated until it can be disproved.

"In entering upon the solution of the problem of three gravitating bodies, we must first examine and see of what elements the problem is composed.

"The elements which I shall consider in this case, will not be such as a mathematician of the schools would think it necessary to consider. They will be far more simple, more conclusive (for such as the schools can furnish, have yet decided nothing), and I think, more comprehensible, yet equally true to nature (for I consult nature's laws only and not the method or opinions of any other man), and equally accurate and precise with any which can be given by any other method.

"And, *first*, each revolving body is impressed by nature with certain laws making it susceptible of the operation of force, which being applied, impels motion. These laws may all be expressed under the general term *forces*, which, though various in their nature, possess an equalizing power, controlling each other in such a way that neither can predominate beyond a certain limit; and consequently, these bodies can never approach nearer to each other than a certain point, nor recede from each other beyond another certain point. Hence, these forces are, at *some mean point*, made perfectly equal, and therefore they may be considered as but one force, and hence but *one element* in the problem.

"*Secondly*, these revolving bodies have magnitude, shape, density, etc., which affect the operations of force in producing motion. These properties of revolving bodies have all the same inherent power of equalization as forces. For example, if density be greater in one than another, then magnitude will be relatively less, force will be less (the direct force), and the momentum from velocity greater, but the whole shall be equal. On the other hand, if magnitude be greater, and density less, then force will be greater and velocity less, but the whole shall be equal.

"The second element of this problem may, therefore, be comprehended under the term *magnitude*, which shall include shape, density, and every other quality or condition which affects the operation of force in producing motion, and the whole constitute but one element in the problem, which I term *magnitude*, as referring to the bodies themselves rather than to any of their qualities, as density, gravity, or otherwise.

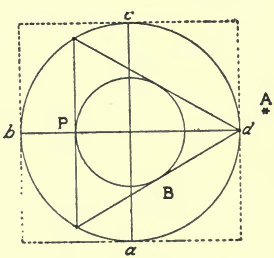
"The third element in this problem is *distance*, by which I would be understood to mean *the chosen distances* from one another, at which these bodies perform their revolutions in space. It is well understood, that from the nature of the case, these revolving bodies must take up their mean distances from one another in exact proportion to their respective magnitudes and forces, and in proportion as these are greater or less, the distance from each other will be greater or less. Hence, it is seen that the same inherent power of equalization exists in respect to distances as in respect to the forces and magnitudes, and whether their distances from each other be greater or less, equal or unequal, they still constitute but one element in the problem.

"The *fourth* and *last element* in this problem is *motion*, or *velocity*, by which distances are to be performed or overcome by revolution. And here again, it will be seen, that because the distances to be thus performed by revolution depend entirely on the *chosen distances* from one another, and these again depend on magnitude and force, therefore the same equalizing power exists in regard to motion or *velocity*, as exists in regard to all the other elements, and therefore this also constitutes but one element in the problem, which I will term velocity, as including momentum, and every other quality, condition, or effect of motion.

"These *four in number*, are all the elements necessary for the *mechanical* performance of the problem, and consequently all that are necessary for its *determination* by *numbers;* and it has been seen that such is the nature of the problem itself, and the power of these elements over one another, that every other quality or condition affecting either, is equalized by, and held in subservience to these, and these again are equalized by, and held in subservience to *one another*, and all controlled by magnitude, so that the whole constitute but *one problem* or *mechanical* operation in which *four elements* are concerned.

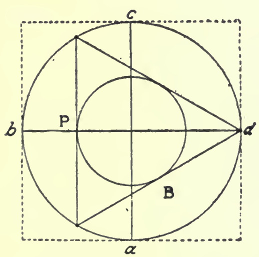
"The difficulty of reducing impalpable things to a palpable standard of measure is generally conceded; but, in this case, I think the difficulty does not exist, and that these elements may all be as truly represented by numbers and magnitudes as if they were palpable things in themselves, having the qualities of length, breadth, and thickness. For example, let a stone be a magnitude, having shape, bulk, density, etc. Now, a *force* which can raise this stone one foot from the ground, and hold it suspended there, is, in its relation to the magnitude or stone, exactly equal to *one foot* of measure; and because the stone is held suspended, and does not descend again, nor rise higher, it is evident that the force and magnitude have *become* *equal at that point of elevation*, and therefore, *vice versa*, the magnitude or stone is, in its relation to the force, exactly equal to *one foot* of measure, and consequently distance and motion are each seen to be equal to one foot; and the same principles of applicability to measure exist in *three* bodies suspended in space, and made to revolve about each other by forces inherent in themselves. It matters not that other and disturbing forces exist outside or inside the space in which these bodies revolve, because, if another and disturbing force be considered, then it ceases to be a problem of *three* gravitating bodies; and also, because such disturbing forces, if they exist, operate proportionally on all *three* of the revolving bodies, and in the course of a revolution, and consequent change of *relative position*, these disturbances *must find* their perfect equality.

"Now, let us suppose that we have here three bodies, revolving together in space by their own gravitating power, and let the magnitudes of these bodies be exactly equal to one another; then their forces shall be equal, their distances equal, and their velocities equal, and it will be seen that they *cannot* revolve *about each other*, but must *follow each other* round a common center, and their relative motion, in respect to any point in space (as the point or star A) must be on the value of the circumference of the circle B, which passes through the center of each body, as in the accompanying figure.



"Now, let us suppose that each of the elements contained in the problem of *three* gravitating bodies, is an equal portion of the *area* of the circle which these bodies describe in a revolution; then the circle will be divided from the center into four equal parts, as at the points *a*, *b*, *c*, *d*, and let each part be equal to *one*. It will be seen that in each relative change of position, each revolving body passes over an area equal to *one and one-third.* In other words, their relative motion is as *four to three.* So, also, if each element shall be an equal portion of the circumference of the circle B, or an equal portion of the square of the diameter of B, the same result is manifest, and the relative motion of each revolving body is as *four to three* of such magnitude as is made the standard of measure.

"Again: *Secondly.* Let the area of the circle *inscribed* in the equilateral triangle, whose sides make the distance between these revolving bodies, be *one*, as in the following figure. It is seen that the circle B, whose circumference these bodies describe by their revolution, is four times greater than such *inscribed* circle. Hence again, their relative change of position is seen to be as four to *three*, or one and one-third of the primary magnitude which is made the standard of measure, and (Proposition I, Sec. 31.) it is seen that the circle inscribed in the triangle, (as follows), forms the basis of the area of that triangle, when it shall be measured by circumference and radius, which are the only legitimate elements of area in all shapes alike.



"Again: *Thirdly.* It is seen that the equilateral triangle [see preceding figure], whose sides make the distance between these revolving bodies, is an angular shape and being measured in the usual way of measuring angular shapes, its area equals the perpendicular P*d*, equal *one.* Then it is seen that the diameter of the circle B, which these bodies describe in a revolution, is one-third greater than the perpendicular. Hence, in performing a complete revolution, these bodies describe a circumference equal to one and and one third the circumference of *one diameter.* In other words, their relative motion is again seen to be as *four* to *three* of *one* primary circumference.

"*Fourthly.* These bodies, which are revolving together, are known (by hypothesis) to be equal to one another in magnitude, and consequently equal to one another in all the elements concerned in their revolution. Now, let us suppose that their distance from each other equals *one*. That distance is seen to be the *side* of an equilateral triangle inscribed in the circle B, whose circumference they describe in one complete revolution. [See preceding figure.] Now, the side of an equilateral triangle inscribed in a circle equals the perpendicular from the base of an equilateral triangle, whose side equals the diameter of the aforesaid circle; and therefore, because the square of the side of *any* equilateral triangle equals one-third added to the square of its perpendicular, and because the *square* of the side of the equilateral triangle inscribed in B equals only, therefore the square of the diameter of B equals *one and one-third*. Hence the area of B equals one and one-third the area of a circle whose diameter is one. Hence, in describing the circumference of B, the relative motion of the three revolving bodies shall be as *four* to *three*, or *one and one-third the area* of a circle whose diameter is *one*.

"By Proposition XII., Sec. 23, it is shown that the true and primary ratio of circumference to diameter of all circles, which can be expressed in whole numbers, is *four times* the *area* of one circle *inscribed* in *one square*, for the ratio of circumference, to the *area* of the *circumscribed square*, for a ratio of diameter. [See preceeding figure] Therefore, it is evident that if the circumference of B shall be resolved into such primary parts as shall express the circumference of *one* diameter in whole numbers, and in its exact relation to area and diameter, without a remainder in either, then the circumference B shall equal *one* and *one-third* of one primary circumference, such as may be expressed in whole numbers; because the area of the square circumscribing B equals *one and one-third*, when the side of the equilateral triangle *inscribed in* B equals *one*.

"*Fifth* and *lastly.* These revolving bodies must be supposed to revolve upon a value, in which diameter and area form exact and equal portions, and the only circle in nature whose diameter and area are equal to one another, and identical in numbers is a circle whose circumference is *four;* hence the relative motion of three bodies of equal magnitude, revolving together, can not be otherwise than one and one-third of such parts.

"It is evident from all the foregoing demonstrations, that, if we suppose the elements of which this problem is composed to be *magnitudes*, and take *them* as a standard of measure, whether such magnitudes shall be equal portions of the area of a circle, or of its *circumference*, or of the *square* of its diameter or whether we take as our standard of measure the *distance between* these revolving bodies, which makes the *side* of a triangle, or the *perpendicular* of such triangle, or its *inscribed circle*; in all cases, and in every case, the relative motion of these three revolving bodies *must be* as *four to three*, or *one* and *one-third of such magnitude as is made the standard of measure*, and there is no other standard of measure which can be mathematically assumed in the premises which I have not here considered.

"*The proposition is therefore demonstrated* that three gravitating bodies of *equal magnitude*, revolving together, their relative motion *shall be* as *four to three*, or *one and one-third of one primary circumference.*

"It will be obvious to anyone that, in the foregoing demonstration, I have assumed that the magnitude of the revolving bodies are all *equal* to *one another*, and hence their forces, distances, and velocities are all *equal to one another;* consequently they all revolve on the same circumference as shown in the several plates; therefore, they cannot revolve *about* each other, but must *follow each other* round a common center. But, in the problem of the revolution of the moon about the earth, and the earth and moon together about the sun; the magnitudes are *all unequal*, and hence their distances from each other, their forces and velocities, are all *unequal*, and they are known *not to follow each other*, as in the foregoing demonstration, but to revolve about each other in the order above stated.

"It may perhaps, therefore, be inferred that the foregoing demonstration is not applicable to such *gravitating bodies*. But it must be observed, also, that the equalizing power of all the elements of the problem *are in full force and operation here*, as well as in the problem just solved, and that the chosen distances, forces, and velocities are in exact proportion to the relative magnitudes of the bodies revolving; and hence their *relative* motion shall be *still the same*, with this difference only, that because the moon revolves about the earth, and the earth and moon together revolve about the sun, *therefore* their relative motions being expressed by time (which is also relative), the following proportions ensue."

(Sec. 34.) While Mr. Parker seeks to set forth his own clearly conceived opinions that nature, in the construction of the solar system, and of the cosmos, founds all bodies as to their size, shape, density, motion, relation to each other, and relative motion to each other, upon an *underlying law*, capable of mental realization and of geometrical setting forth, by which, if some one unit fact of these phenomena is known, then all these various elements may be had in a correlating and co-ordinating method of notation, he also intends to say that there is *one*, and but *one number form*, for a flux through which all these relations may become manifested and known. The base of the law is the relation of the geometrical elements of the triangle, the circle, and the square; the second, or measuring, or notating, stage is the relation of the area and rectification of the circle in terms of the square. Now, these relations may be variously set forth, as of unity for diameter to 3.14159+ for circumference, and so on; but there is but one numerical form for the expression of these relations, through which all these phenomena will correlatively work themselves out, and that is in the Parker forms of 6561 : 5153x4=20612, and *none other;* and this is the form on which under his quadrature value, and his problem of three revolving bodies, Mr. Parker proceeds to the calculation of the time periods of the earth and moon.

Suppose that nature herself recognizes the division of the solar day into the same subdivisions that man does, *viz.*, 5184000''' (or, in other words, suppose that man has been taught these number relations from nature, as by revelation, in whatsoever way we may understand it as coming), as a *time circle* actually made by the revolution of a planet; and suppose she herself has so adjusted her works that *this* circle *has relation* to the *abstract relation* of square area to circular area and circular rectification in *one* peculiar number form, *and none other*, so that she shall preserve harmonious connection in all her works, between geometrical principles of change and the power of translating or notating them through just *these number forms, and none other*. The conclusion is irresistible that the numerical methods, which we as mortals do possess, are, after all, but the very ones which some unseen power has been working by in the very creation of our cosmos, and in some way has actually implanted in us for our use. The test of this is in the application. Mr. Parker has the right of comparison of two distinct forms of circular use. For instance, a point on the equator performs a circle of time in what we call 360 *degrees* of space, or 24 *hours* of time, or 5184000 *thirds* of last subdivisions of time. Then 5184 is the index of this work done and of a circular value accomplished. Again, Mr. Parker finds that 5153 is *abstractly* the area of a circle inscribed in a square of an area of 6561. He has the right to institute whatever comparisons he sees fit between these two relations, *because* of the common property which they have of being circular admeasurements. But this is but his right, and it does not follow that nature has had any like weakness or any like strength of design. However, she has a measure of her own to mark the same time period, which is in the rising and setting of the sun *as a fact*, or in the alterations of day and night. If Mr. Parker's uses are such that nature's use is seen accurately to fit and adapt to them, then instead of speaking of "*Mr. Parker's applications*" we can say and should say "*Nature's applications as discovered by Mr. Parker.*"

(Sec. 35.) Mr. Parker takes the characteristic value of a solar day as a circular admeasurement in its division of 5184. With this he claims that in nature, the abstract value of circular area is connected in mechanical construction, which value is 5153. As the one is the solar day *value in thirds*, so he makes the second the *abstract circular value in thirds*, or like denomination. He says:

"The length of one 'circular day' is 5153000‴

"The length of one 'solar day' is 5184000‴

"The length of one 'sidereal day' is 5169846‴

"The difference between one circular and one solar day is 8′ 36″ 40‴ (or, it is 31-000‴, the differential 31 being a number of great use).

"The difference between one circular and one sidereal day is 4′ 40″ 46‴."

His relation of area of square to that of inscribed circle is: area of square, 6561; area of inscribed circle, 5153.

His relation of rectification is: diameter of circle, 6561; circumference of circle, $5153 \times 4 = 20612$.

His general formula for the calculation of time periods, under his "problem of the revolving bodies," is:

$$20612 \times \tfrac{4}{3} = 27482.666+, \text{ and this } \times \tfrac{4}{3} = 36643.555+,$$

in which the base is the area of the inscribed circle x by 4 = its rectification; the second term is numerically the value of the moon's lunation, and the third is the base of the calculation of the solar year. To illustrate what has been said: Take the second term as the value of the moon's lunation; numerically it is the value of *abstract* circumference, plus *one-third* of itself, and Mr. Parker says of it that it is "the value of the moon's passage around the earth *over* the value of one complete circle in space, in circular days"; that is, it is in terms of the abstract value of 5153 and in its denominations, for it was raised from it. Reduce this to solar time, thus:

$$27482666+\times\frac{5153000}{5184000}=273183220164+:$$

Take this result as 27.3183220164 + solar days, and reduced to the proper divisions of solar time, there results 27d. 7h. 38′ 23″ 1‴ 20⁗. Now, this result is too small for a sidereal lunation by the quantity 4′ 40″ 46‴, but strangely enough, or rather magnificently enough, as proving all that has been advanced, this quantity as will be seen by reference to the differences above, is *just the difference between one circular and one sidereal day*, that difference being just 4′ 40″ 46‴. Thus there are the integral calculations: (1.) The Parker abstract form, raised by his problem of three revolving bodies, to a numerical value of a sidereal lunation, which, (2.) reduced to solar circular value, by the addition of the difference between the abstract circular value and the real sidereal value of a solar day, gives the real *mean lunation* in *natural periods of days*. There could be no stronger proof that in our resultant number forms of 360 degrees, 24 hours, and 5184000‴, we have simply been making use of a system with which we have had *no hand or part in its invention*. It is to be observed that this result is *one-fifth of one second* in a lunar month, less than the period given in astronomical time. But let it be remembered that from the received astronomical value, it has been inferred that with regard to *ancient* astronomical time, the moon's motion has been accelerated, and this has given rise to the opinion that the solar system of movement is winding down, or closing up. By Mr. Parker's time, on this same ground, the moon's is shown to be equable and perfectly true to itself, going to show that the solar system is not a system of *projectiles*, but is a *permanency*, having a far more subtle and *life-like* cause of movement.

The third term of Mr. Parker's application of his problem of three revolving bodies, is 36643.555 +, which he says is "the exact value of the earth's passage around the sun, over the value of one complete circle in space, in circular days"; and on this he proceeds to the reduction to the exact period of the earth in solar time.

(Sec. 36.) His periods of time agree to a marvelously small fraction with the standard periods. The following tabulation shows this:

(1.) A Sidereal Lunation.

Astronomical time	27d. 7h. 43′ 4″
By Mr. Parker	27d. 7h. 43′ 3″ 47‴ 20⁗

(2.) A Solar Lunation.

Astronomical time as usually given	29d. 12h. 44′ 3″
By Mr. Parker	29d. 12h. 44′ 2″ .84+
The synodic period, as given by McKay, the English navigator	29d. 12h. 44′ 2″ 48‴
By Mr. Parker	29d. 12h. 44′ 2″ 50‴ 31⁗

(3.) A Mean Year.

Astronomical time as given "sixty-one years since,"	365d. 5h. 48′ 49″
"By the latest authorities as taken from a work of Dr. Dick"	365d. 5h. 48′ 51″
By Mr. Parker	365d. 5h. 48′ 50″ 53‴ 6⁗

(4.) A Solar Year.

Astronomical time	365d. 5h. 48′ 6″
By Mr. Parker	365d. 5h. 48′ 6″ 1‴ 6⁗

(Sec. 37.) The above statements are given to exhibit the use made by Mr. Parker of his problem of three revolving bodies, based on his abstract circular values, and the use of the *factors* 4 and 3 in the formula

$20612 \times \frac{4}{3} = 27482.66+$, and this $\times \frac{4}{3} = 36643.55+$;

the use of which factors will be shown to be very prominent in the pyramid works and measures.

And here, as in relation to his Quadrature, it is stated distinctly that the setting forth of the problems or claims of Mr. Parker are not in any way as affirming either his establishment of the Quadrature or of the problem of three revolving bodies. *It is absolutely necessary* to set forth the results of his labors, because it will be shown beyond all controversy, that the construction of the Great Pyramid was the *architectural display of his results;* and without the use of his conclusions and results, it will *forever* prove impossible to reconstruct that mass agreeably to the conception of the architect.

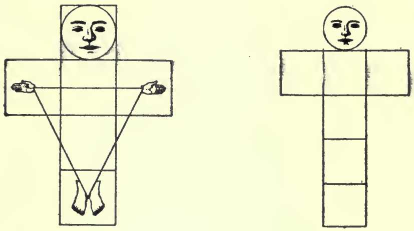
THE ANSATED CROSS OF THE EGYPTIANS AND THE CHRISTIAN CROSS THE EMBLEMATIC DISPLAY OF THE ORIGIN OF MEASURES.

(Sec. 38.) If it is desired to display the process of the establishment of the co-ordinating unit of measure spoken of, by way of symbol, it would be by *the figure of the cube unfolded, in connection with the circle, whose measure is taken off onto the edges of the cube.* The cube unfolded becomes, in superficial display, a *cross proper*, or of the *tau* form, and the attachment of the circle to this last gives the *ansated cross* of the Egyptians, with its obvious meaning of the *origin of measures.* Because, also, this kind of measure was made to co-ordinate with the *origin of human life*, it was secondarily made to assume the type of the pudenda hermaphrodite, and, in fact, it is placed by representation to cover this part of the human person in the Hindu form. It is very observable that, while there are but six faces to a cube, the representation of the cross as the cube unfolded, as to the cross-bars, displays one face of the cube *as common to two bars*, counted as belonging to either; then while the faces originally represented are but 6, the use of the two bars counts the square as 4 for the upright and three for the cross-bar, making seven in all. Here we have the famous 4 and 3 and 7. The 4 and 3 are the factor numbers of the Parker problem. But, what is very much to the purpose here, is, that the *golden candlestick* in the temple was so composed that, Counting on either side, there were *four* candle-sockets; while, at the apex, there being *one in common* to both sides, there were in fact 3 to be counted on one side and 4 on the other, making in all the number 7, upon the self-same idea of one in common with the cross display. Take a line of one unit in breadth by 3 units long, and place it on an incline; take another of 4 units long, and lean it upon this one, from an opposite incline, making the top unit of the 4 in length the corner or apex of a triangle. This is the display of the candlestick. Now, take away the line of three units in length, and *cross* it on the one of 4 units in length, and the cross form results. The same idea is conveyed in the six days of the week in Genesis, crowned by the seventh, which was used by itself as a base of circular measure.

(Sec. 39.) These are symbols of ancient use of the Parker forms and their connections. It serves but to confirm this use to notice the conclusion to which Professor Seyffarth arrived at from the study of the Egyptian hieroglyphic signification of the ansated cross. It will be observed that this cross, being surmounted by the circle, or circular figure, in fact roughly represents the form of a man, with arms extended. Professor Seyffarth says: "It represents, as I now believe, the skull with the brains, the seat of the soul, and with the nerves extending to the spine, back, and eyes or ears. For the Tanis stone translates it repeatedly by *anthropos* (man), and this very word is alphabetically written (Egyptian) *ank*. Hence we have the Coptic *ank*, vita, properly *anima*, which corresponds with the Hebrew *anosh*, properly meaning *anima*. The Egyptian *auki* signifies *my soul*."

It is curious that this Hebrew equivalent, *Anosh*, for "*man*" by Prof. Seyffarth, reads numerically 365—1, which could be intended to mean either $365+1=366$, or $365-1=364$, or the time phases of the solar year, thus shadowing forth the astronomical connection.

The Hebrew word for a *lunar year*, "shanah," directly connects the idea of "*man*" with an astronomical value, as also an abstract circular value. As said, the two values of 113 to 355 and 6561 to 20612 are, as it were, *welded* together in ancient use. The attachment of a man to the cross would be, in display, the symbol of such welding. In fact, this is a plainer and more perfect symbolization of



the ancient use than any other. It was one made use of in this form of display by the Hindus. In fact, the Old Testament is rabbinically and kabbalistically familiar with the expression of crucifying a man, or men, before the Lord and *the sun*. In symbol, the nails of the cross have for the shape of the heads thereof a solid pyramid, and a tapering square obeliscal shaft, for the nail. Taking the position of the *three* nails in the man's extremities, and on the cross they form or mark a *triangle* in shape, one nail being at each corner of the triangle. The wounds, or *stigmata*, in the extremities are necessarily *four*, distinctive of the *square;* and, as in the candlestick, there have been two used as one, or rather one used as two, in the connection of the *three* nails with the *four* extremities. The three nails with the three wounds are in number 6, which denotes the six faces of the cube *unfolded*, on which the man is placed; and this in turn points to the circular measure transferred onto the edges of the cube. The *one* wound of the feet separates into *two* when the feet are separated, making *three* together *for all*, and *four* when separated, or 7 in all—another and *most holy feminine* base number.

PRIMORDIAL VESTIGES OF THESE SYMBOLS

Under the general view taken of the nature of the number forms of Mr. Parker, it becomes a matter of research of the utmost interest as to when and where their existence and their use first became known. Has it been a matter of revelation in what we know as the historic age—a cycle exceedingly modern when the age of the human race is contemplated? It seems, in fact, as to the date of its possession by man, to have been further removed, in the past, from the old Egyptians than are the old Egyptians from us.

(Sec. 40.) (1.) THE EASTER ISLES in "*mid-Pacific*" located about 2,300 miles from the S. W. coast of South America, in 27° 6′ S. Lat., and 109° 17′ W. Long., present the feature of the remaining peaks of the mountains of a submerged continent, for the reason that these peaks are thickly studded with cyclopean statues, (*some of which exceed 27 feet in height*), remnants of the civilization of a dense and cultivated people, who must have of necessity occupied a widely extended area. On the backs of these images is to be found the "*ansated cross*," and the same modified to the outlines of the human form. A full description with plate showing the land, with the thickly planted statues, also with copies of the images, is to be found in the January number, 1870, of the "*London Builder*". Some of the statues exhibiting the markings of the cross, it is thought, are in the *British Museum*. It will be *noted*, that the "Easter Isles" are the exact "*antipodes*" of the territory of Southern Egypt, immediately surrounding the Great Pyramid Jeezeh. This will, in a manner, account for (at least) *a partial* preservation of the "Easter Isles" during the last cataclysm, occupying as they do, the poising point of the earth, exactly opposite the Great Pyramid.

(2.) CRUCIFIED MAN OF SOUTH AMERICA.—In the "*Naturalist*," published at Salem, Mass., in one of the early numbers (about 36), is to be found a description of some very ancient and curious carving on the crest walls of the mountains of South America, older by far, it is averred, than the races now living. The strangeness of these tracings is in that they exhibit the outlines of a man, stretched out on a cross, by a series of drawings, by which from the form of a *man* that of a *cross* springs, but so done that the cross may be taken as the man, or the man as the cross; thus exhibiting a symbolic display of the interdependency of the forms set forth in the text.

THE CONSTRUCTION OF THE GREAT PYRAMID.

(Sec. 41.) To a mind unbiased by the possession of previous fixed theories, the assertion that the Great Pyramid of Egypt was built for the *dual* purpose (1.) "to perpetuate a series of weights and measures, astronomical and otherwise, containing a system of mathematical and geometrical admeasurement," and (2.) for an "Initiates Asylum wherein adepts were obligated in the hidden mysteries," can be received with credulity—and the only possible theory left, but what has already been investigated and in the main found wanting. None but proof of an extraordinary kind as to ability to reconstruct, after the mental conception of what the architect intended to represent, ought to become, or will become, acceptable. This is especially the case where the time of the building of the mass dates back beyond what may be called the historic age, and where every theory advanced must rest for support upon *its own intrinsic merit*, unsupported by positive evidence of any kind filtering through the *historical* channels of the world.

The further step required is, of eliminating *all* theory, and *all* probability, and *all* possibility, leaving a standard of measure as fixed and rigid, for instance as the *English inch.* As a sequence to this, the restoration of the mass is to be made in terms and divisions of this measure. Subject to these considerations, and they seem to be fair and pertinent, if a standard of measure can be arrived at, as a rigid and fixed one, derivable from an elemental source, by use of which a structure can be erected, as to its whole and most of its parts, similar to that of the Great Pyramid in its geometrical shapes, and in such manner that the evidence is convincing that the actual measure of its original construction is being used, then, indeed, the recognition of that standard, its source, and its use in that connection, it is thought, should be conceded, even though the particularities of the method of use may not be certain.

Before closing this work in a coming chapter, we shall *attempt* to show that there are *other* and even more important rooms in this *great asylum*, than have yet been exposed to "*eavesdroppers*" and the vulgar public. To any that have "*traveled extensively*," or knocked at the outer portals of any of the principal *Secret Organizations*, will recognize in the great stone *Sphinx*, a part and parcel of the Great Pyramid. You may call it, the Tyler, or Sentinel, or Outer Guard, etc., through which, *some time in the future*, the entrance to the Great Pyramid will be effected, and not *via* the northern, narrow, astronomical passage, built only for the purpose of exposing to an *initiate*, his "guiding star" during his travels.

(Sec. 42.) Professor Piazzi Smyth has given to the world a mass of measures of this structure. He was laboriously, and even painfully, careful in their taking, on a measure adjusted to the British *standard* at Edinburgh, even to the balancing and dwelling upon *tenths* and sometimes *hundredths* of inches. He had found such discrepancies in the measures of the multitudes of those who had preceded him that he was prepared beforehand for his work. Besides, he desired to discover who of those others had done their work well. Of those who had preceded him, he found the measures of Col. Howard Vyse, of the French *savants*, and of Professor Greaves, exact and reliable.

That it is next to impossible to have measuring instruments alike, though taken from a same standard; and it is almost impossible that, even though having the same measures, their uses will bring out the same results. Discrepancies are liable, from these causes, to show themselves in *tenths* of inches, and even more, where lengths of thirty or more feet are taken. No one better appreciated this statement than Professor Smyth.

As to the objects of construction of the Great Pyramid of Egypt: the one most generally accepted is, that of an *astronomical center*, from the facts that the *north base side* of the structure coincides with the parallel of 30° north latitude, and that the mass, as to its sides, evidenced by its corner socket lines, are oriented more perfectly than could be expected of human ability today.

The Rev. Mr. Taylor, who made this structure a study in his day, saw its *geometrical* side more than any other, and thought that it was so built that its height should be to *one-half* its circumference as diameter to circumference of a circle. Corroborated later by the measurements of Prof. Smyth; who upon carefully taken measures, linear and angular, and upon computation, comes to the result that the structure was: In height, 486 feet 2 inches; and that its base side was, by the measures of Col. Howard Vyse, in length, 764 feet, and by the measures of the French Corps, 763.62 feet.

STANDARD MEASURES OF THE KING'S CHAMBER.

(Sec. 43.) Take, as one set of derivations in detail, the dimensions of the King's chamber:—

(1.) 206.12 inches $\div$ 12 = 10 cubits +, or 17.1766 + feet.

(2.) 17.1766 + feet x 2 = 20 cubits +, or 34.3533 + feet.

$$(3.)\quad \left.\begin{array}{c} 20.612 \div \dfrac{17280}{16} \\ \text{or} \\ 34.3533 \times \dfrac{10}{18} \end{array}\right\} = 19.0851+ \text{ feet.}$$

Which measures, agreeably to the conditions, are the measures, taken at *the standard*, of the King's chamber; (1.) or 17.1766 +, being *standard breadth*, (2.) or 34.3533 + being *standard length*, and (3.) or 19.0851 +, being the *standard height*, all in *English feet;* subject to variations therefrom for special purposes, as will be shown. The measures of this chamber, as given by Prof. Smyth are: breadth, 17.19 feet; length, 34.38 feet; height, from

19.1 feet to 19.179 feet. (As to height, Professor Smyth gives his measures 19.1 to 19.179, with allowance, or as conjectured, because of the broken state of the floor when he took them. "*Floor broken up thus since the measures of Col. Howard Vyse.*" His measure for height was 19.1 feet.)

ACTUAL PYRAMID MEASURES, AS ENLARGEMENTS ON THE STANDARD, WITH THE REASON FOR THE VARIATION.

(Sec. 44.) The following is a method of variation on the standard measures as given; and one which seemingly controls the entire pyramid structure. The Parker elements are 20612 to 6561. The cubit value is $20.612 \div 12 = 1.71766+$ feet; and 10 cubits are $17.1766+$ feet. If the value of diameter 6561 taken as feet, be divided by $17.1766+$, or the measure of 10 cubits, thus derived, the quotient will be $381.97166+$ feet. This method is given for its results in the actual measure desired.

This, in effect, is the same as the division, or quotient, of diameter value of 6561 by circumference value, or 20612, under a formulation to obtain *a diameter value to a circumference of unity*, thus:

(1.) $20612 : 6561 :: 1 : .3183097+$, and,

(2.) $31.83097 \times 12 = 381.97166+$,

and this $\times\, 2 = 763.94333$.

The effect is a very curious one. Take the following:

(3.) $20612 \times \dfrac{4^2}{3^2} = 36643.55 \div 48 = 763.407+$,

where the standard base side is obtained from the primary *circumference* value. By (1.), 31830907 is a *diameter* value, and raising it as shown, it becomes 763.94333, being almost the same by comparison. Then, working in *circumference* values, the standard pyramid measures are found; working in *diameter* values, the *exactitude* comes by *the enlargement.* Referred to a primary principle, *original circumference* is 20612; changing to *diameter value*, it becomes $20626.47001+$.

(45.) The standard of the size of the pyramid is, 763.4074+ feet. The half of this is 381.7037 + feet. Compare this value with that obtained by the method of variation shown in (Sec. 44.): standard, 381.7037 +, variation, 381.9716+.

This last multiplied by 2=763.94333+ feet for the side of base of pyramid, instead of 763.4074+feet; and let it be assumed that this was, in fact, a variation taken on the standard measure, *yet one growing out of the Parker elements*.

Taking the base side at 763.94333+ feet, the proportionate height of the mass would be, 486.341+ feet, instead of 486 feet *as by the standard*.

This measure of the pyramid's base agrees with that taken by Col. Howard Vyse, as follows: Vyse, 764.000 feet, Above 763.943+feet, Difference .056+ feet, or, to be within less than one inch in 9168 inches.

If this variation on the standard be applied, for the admeasurements of the king's chamber, to ascertain the enlargements on the standard, there will result the following differences: *viz.*—less in breadth, by 13-10000 (.0013) of a foot; less in length, by 26-10000 (.0026) of a foot; and less in height by 15-10000 (.0015) of a foot. Or, literally the difference has become so inappreciable that there is no method of ascertainment as to what the correct admeasurement is by any practicable test of actual measure. *If, however, a law can be ascertained*, which will in its fulfillment demand the use of these variations on the standard, then they should be considered as data correctly taken. *There is such a law;* and its demands as to their nature coincide with the spirit or genius of the pyramid structure, as a measure of time.

ENUNCIATION OF THE LAW.

(Sec. 46.) The very great value of the number 6 as a factor, is at once recognized in the base of the English (British and U. S.) *long* and *land* measures, and also in the construction of the celestial time circle. That circle is of the value of $360°$; it is divided into *minutes*, *seconds*, *thirds*, etc., in the scale of $60' = 1°$, $60'' = 1'$, $60''' = 1''$, and so on. This circle is subject to another division, as applied geographically to the earth, where $360° \div 24 = 15°$ to the hour of longitude, where 24 is also a multiple of 6, as $6 \times 4 = 24$, and where each degree $= 69+$ miles English. The primary division of this circle is on the base of 6 parts, subdivided for each part into 3600 parts, or $6 \times 3600 = 21600'$; or, $360° \times 60' = 21600'$.

Now, by the variation on the Parker elements (standard), worked out, as seen, through the simple use of the elements themselves, the result is obtained of a diameter value (by change on a circumference value), of 190985+. From enlarged length of the King's Chamber, *viz.*, $34.3774 \times \frac{10}{18} = 19.0985$. *This factor*, 6, which is of such great value, *is not taken empirically*, merely because it proves to be of such great practical use in the admeasurement and subdivision of time periods of land measuring rests, or stops, *but it is a legitimate circumference value, derivable from this variation on the standard of the Parker elements of diameter and circumference*, for (1.)

$6561 : 20612 :: 381.97166 : 1200 :: 190.985+ : 600 :: 1.90985 : 6$;

where the reduction from $\frac{6561}{20612} = 318309 + \times 12 = 38197166$ or $\frac{6561}{17.1766} = 381.97166$, divided by $2 = 190.985$, becomes the diameter value of a circumference of 600; or, 1.90985 becomes the diameter value of a circumference of 6; and this properly, and rightly, and exactly, belongs to the use of the Parker elements; so, this height of the king's chamber is diameter to a circumference of 60. See the play of change! The Parker circumference 20612, changed to a *diameter* value of variation, gave the exactitudes of measure of the pyramid in diameter for circumference terms.

Among these is the height of the king's chamber, which now turns out to be a means of regetting an integral circumference value, in the Number 6, or 60. *The obtaining of this end seems to be the law of pyramid actual construction.*

(2.) $19.0985 + \text{ inches} \times \frac{216}{10}, \text{ or } \frac{6^3}{10} = 412.5294 +$ inches, which equals the length of the king's chamber *in inches*, as the enlargement or variation on the standard; and,

(3.) $6561 : 20612 :: 412.5294 + : 1296$;

or, there results, the length of the king's chamber, in inches, as a diameter value, proportioned to the number of inches in the *square yard British*, as a circumference; and it is well to reflect that $1296 \times 4 = 5184$, the characteristic value of one solar day reduced to *thirds*.

(4.) $\frac{41259.24 : 129600}{6} = 6875.48 + : 21600$, and,

(5.) $\frac{6875.48 : 21600}{360} = 19.0985 : 60$;

where the celestial, or geographical earth, circle of (6×60, or) $360° \times 60'$, equals $21600'$ of division, in terms for circumference to height of the king's chamber as diameter. This, as a foundation, embraces all the time subdivisions of that circle into *hours* (24 equal to 1 solar day of $\left(\frac{144}{2}\right)^2 \times 1000 = 5184000'''$, as well as the distance divisions of the circumference of the earth in miles to the degree), *minutes*, or *primes*, *seconds*, and *thirds*. So, also, as to the width of the king's chamber.

(6.) $6561 : 20612 :: 206.264 +$ inches : 648 inches.

So the law of construction of the pyramid is assumed to have been found on this showing.

NOTE:—That the base side of the pyramid, by actual measure, being thus shown to be a diameter of $\overline{763.943+}$ to a circumference of 2400 feet, this is 24×100, and 24 is four times the factor 6. The base of the pyramid, then, would be co-ordinately represented by a square of 24, or

$6 \times 4 = 24$, to the side; and this is the Garden of Eden form: and, also, it is the square Hebrew Zodiac of the 12 months.

THE DISCOVERY OF THIS LAW.

(Sec. 47.) The discovery of this law, and of its application, arose from a suggestion of thought on reading a passage in the "*Historical View of the Hindu Astronomy*," by Mr. John Bentley. It is almost evident that one intention of the architect of the pyramid, has been exactly reproduced in the use of a numerical system; and this accomplishment is but the going back to the original sources of the numerical instrumentalities which are in use today. Considering the value of this discovery, it is appropriate to give the original notes made on the subject as follows:

A very remarkable blending of all these systems can be given, arising from the actual method used by the Hindus for the calculations of *sines*, *tangents*, *cosines*, *cotangents*, etc., which belongs to their most ancient system of astronomical calculations. This method is given by Mr. John Bentley, in his "*Historical View of the Hindu Astronomy*" (Sec. 3, page 156). He is giving the various values for the computations of the value of *pi*, one after the other, until coming to one very nearly approximating the true relation, he says:

"But Argabhatta, in the 17th chapter, in speaking of the orbits of the planets, gives us a nearer approach to the truth; for he there states the proportion as 191 to 600, or as 1 : 3.14136, which gives the circumference a small matter less than the proportion of Bhaskara in the Lilavati. This, however, is not the invention of Argabhatta; for it is employed in the Brahma Siddhanta, Surga Siddhanta, and by all astronomers before the time of Argabhatta, as well as since, for computing the tables of sines, etc., though not immediately apparent. Thus, in computing the sines, they take the radius at 3438′, and the circumference they divide into 21600′; the diameter is therefore 6876: hence the proportion is 6876 : 21600. Reduce these numbers to their last terms by dividing them by 36, the result will be 191 : 600, as stated by Argabhatta." Mr. Bentley, greatly familiar with Hindu astronomical and mathematical knowledge; not as a foreigner studying the reach of a nation in such matters, but as a resident in Hindustan of some fifty years. This statement of his may, then, be taken as authentic. The same remarkable trait, among so many Eastern and ancient nations, of sedulously concealing the arcana of this kind of knowledge, is a marked one among the Hindus. That which was given out to be popularly taught, and to be exposed to popular inspection, was but the approximation of a more exact but hidden knowledge. And this very formulation of Mr. Bentley will strangely exemplify the assertion; and, explained, will show that it was derived from a system exact beyond the European one, in which Mr. Bentley himself, of course, trusted, as far in advance of the Hindu knowledge, at any time, in any generation.

"This formulation is the taking of a radius of 3438 to obtain a circumference to be divided into 21600 equal parts. The diameter would be 6876, and the reduction of this by 36 would be 191. Now 216 is 6^3, or, $\overline{36 \times 6}$, which shows use of a system founded on a multiple of which 6 is the basic factor; 3438 is an exceedingly near approach to a pure circumference value, which goes to show, as it is used as a radius, that which has been so observable heretofore of the expression of diameter, or straight line, values in terms of circumference.

"Take the reduction of 20612, the Parker circumference value, that give the dimensions of the king's chamber:

(1.) $20612 \div 600 = 34.3533+$ feet = standard length.

(2.) $20612 \div 1200 = 17.1766 +$ feet = standard width.

(3.) $\left.\begin{array}{rr} 20612 \div & 1080 \\ 343.533 \div & 18 \\ 190.851 \div & 10 \end{array}\right\} = 19.0851 +$ feet = standard height.

"These are the standard measures of these dimensions, for comparison; or, on which variations are raised in the working out of various problems for which they were the base. Take it that this Hindu problem involves these measures, and that the system of factoring by 6 is introduced, by which with these measures to work out tables of *sines*, *cosines*, *tangents*, *cotangents*, etc., and for calculations of *planetary times*, or distances. So (1.) perfect circular elements are required; and (2.) the circumference of these elements is to be divided into 21600 equal parts. Cannot the Hindu system be traced back to an absolutely perfect one, based on the Parker elements? And, at the same time, cannot this same Hindu system be attached through the same Parker elements, by actual measures, to the king's chamber, the passage way therefrom, and to the ante-chamber works? If this can be done plainly, and mathematically, it will be an important achievement.

MEASURES AS ACTUALLY MADE OR COMPUTED IN TERMS OF THE ENGLISH INCH AND FOOT.

(Sec. 48.) Height (estimated or computed by Prof. Smyth), in feet.................................486.2
Side of base (French measures) in feet...........763.62
Side of base (Col. Vyse's measures), in feet........764.0
Length of King's Chamber, in feet.............. 34.38
Width of King's Chamber, in feet.............. 17.19
Height of King's Chamber, in feet.............. 19.1

EQUATORIAL AND POLAR DIAMETERS OF THE EARTH.

(Sec. 49.) Equatorial diameter (as ascertained) of the earth in feet..........................41,852,864+
Polar diameter (as ascertained) in feet......41,708,710+
Difference..................... 144,154+
Equatorial diameter in English miles........ 7,926.9268
Polar diameter in English miles........ 7,899.6248
Difference....................... 27.3020

Let the values of the earth's diameters be taken at, for
Equatorial diameter.................. 41,854,174 + feet
And another at some other point.......41,739,954 + feet
Difference is................ 114,219.758

If the larger diameter be divided by this difference the quotient will be 366.4355+, and this is numerically that value springing from the Parker elements of $206.12 \times \frac{4^2}{3^2} =$ 366.4355 +, which as he says, is "the exact value of the passage of the earth about the sun over one complete circle in space in circular days'; and used otherwise for pyramidal purposes, is in 36643.55 inches the standard circumference of the pyramid.

[The question has been raised, by what authority Parker points this value at 366.4355+, and in truth he is not clear on this. But a way can be shown, by throwing the values from inches into feet, thus: $\frac{20612}{12000} = 1.71766$ feet, or the value of one cubit; 120 cubits, then, is 206.12 feet, and this $\times \frac{4^2}{3^2} = 366.4355+$, as the Parker time day value, thus shown to be in British feet.]

In this formulation, since the smaller diameter taken is less than the dividend by the amount of the divisor, the quotient of the smaller divided by the difference, will be *one less* than the first quotient, or 365.4355+. There results:

$$\left.\begin{matrix} 366.4355 \\ 365.4355 \end{matrix}\right\} \times 114219.758 = \left\{\begin{matrix} 41{,}854{,}174+\text{feet} \\ 41{,}739{,}954+\text{feet} \end{matrix}\right.$$

where the products are the return of the diameter values of the earth as taken.

THE DIMENSIONS OF THE DESCENDING PASSAGE WAY.

(Sec. 50.) [NOTE.—This (misnamed) 'entrance' or "descending passageway" of the Great Pyramid is located on the north side of that structure, at a point 24.42 feet east of the axial line of the pyramid, and begins its descent in a southerly direction at a point 49 feet above the pavement. To get to the mouth of this (*misnamed*) "entrance passageway," when the north pavement was clear from sand and other *debris*, and the angle casing stones were all in position, a visitor would have had to scale the side of the pyramid at an angle of 51° 51′ 41.3″, up 49 feet, then shorten his height (*by crouching*) to 47 inches, to be able to descend this narrow '*passage*' at an angle of 26° for 82 feet, before he could stand erect. *A very improbable proposition.* For *these* and other *tangible* reasons, we shall presently state that this was not the original entrance to the building; in fact, never intended as an entrance at all. Another, and the real entrance, will be named to all those *worthy and well qualified* to enter, before closing the final chapters of this work.]

The questions as to the descending passageway may now be taken up. It has been seen that all the measures of *this* pyramid have their origin in the relation of circumference and diameter values of a circle. It will be exceedingly appropriate that in the act of entering the passageway, one should, as a matter of fact, enter through the actual expression of those values. Such seems to have been the case. Col. Vyse's measures of this passage are:

(1.) Breadth .... 41.5 inches
Height perpendicular to incline.... 47.0 inches

Professor Smyth's measures are grouped together, as means of a series, and are as follows:

(2.) Breadth near bottom..... 41.61 to 41.46 inches
Breadth near top.......... 41.63 to 41.41 inches
Mean of all........................ 41.53 inches

(3.) Height perpendicular to incline:
West side of floor.............. 47.16 to 47.30 inches
East side of floor.............. 47.14 to 47.32 inches
Mean of all................... 47.24 inches

but he characterizes this measure as 47.3 inches.

(4.) Height verticle to base of pyramid:
In one place, 52.68 inches; in another place, 52.36 inches. There seems to be very little, if any, difference between the dimensions of the descending, and of the ascending, passageway; and, as the red granite portcullis blocks seem to have been intended to give these measures, it is well to give Prof. Smyth's measures of the same, *viz:*

(5.) Height perpendicular to incline.......47.3 inches
Breadth..........................41.6 inches
Height verticle to base of pyramid....53.0 inches

(Sec. 51.) THE TROWEL FACE.— The commencement of the pyramid proper was by placing an ideal pyramid in a sphere. In that problem, *all* the pyramid elements of construction are displayed. So that a *mason's trowel* constructed after those proportions, on the scale of the English inch, would afford to the mason the whole elaborate plan of his work with the relations of the elements from whence these plans took their rise. Let us now diverge from the pyramid proper, for an investigation of the measurements of the Temple of Solomon.

It was an old tradition that in the accomplishment of any great and good work involving the more abstruse and recondite knowledges, the workmen would be beset by the powers of the realms of darkness, with their frights, and horrors, and scares. As against these the master workman would protect his work by the display of the seal of Solomon, the wise man, and the king, even over the *Efreets*, the *Jinn*, and the *Jann*. But even here, he had to summon up an amazing amount of resisting force; nor could he do this unless by the assistance of the unseen powers of light, of truth, and of goodness. As encouragement to the failing power and courage of the master workman, on whom the whole charge rested, a voice, like as the *Bath-Col, Daughter of the Voice*, would come, in terms, like the following, which were given to Hasan El Basrah in his terrible trials:

"I disposed thine affair at the time when thou wast in thy mother's womb,

"And inclined her heart to thee so that she fostered thee in her bosom:

"We will suffice thee in matters that occasion thee anxiety and sorrow:

"So, submit to us, and arise: we will aid thee in thy enterprise."

THE TEMPLE OF SOLOMON.

(Sec. 52.) Kabbalistic tradition, passed down in *Succoth*, states that when Solomon was about to erect the temple, he found the measure wherewith to build it, by placing the name of *Jehovah* upon the round mouth of the well hole in digging the foundations; and, again, it is said, by placing this name upon the 'bung-hole' of a cask. The *round mouth* and the *bung-hole* were circles. The Israelites converted circular and spherical measures into square and cubic measures, in their representations of them. It will be shown that the, or one of the, values of the name *Jehovah* was that of the diameter of a circle; and it especially meant the unit measure of a *right-line*, or square surface, or *cube-solid*, having a purely circular value. Hence the definition of the architectural idea of construction is thus conveyed in *Succoth*, if this was the channel of the tradition.

The description of the temple measures are to be graded in the following order:

(1.) From the *Book of Kings*. (2.) From the description of the *Tabernacle;* because it was perfect in all its proportions, and Solomon could do no more than to reproduce it, however much he might vary the style of architecture. (3.) From the *Book of Chronicles*, not so authentic but rather a targum, or paraphrase, on Kings; and (4.) from *Josephus*.

DETAILS OF DESCRIPTION.

(a.) The entrance to the temple faced toward the *east*, and the holy of holies was in the extreme west end.

As to the ground plan, the description in I Kings 6, is concise, plain, and specific. This ground plan has three distinctly separated parts: (1.) The *house*, 'Bayith.' (2.) The *temple*, or open vault of heaven, before the face or door of the house, 'Hecal.' (3.) The *porch* before the face or door of the temple, 'Olaum.' Verse 2 says: "And the house which King Solomon built for the Lord (Jehovah), the length thereof 60 cubits, and the breadth thereof 20, and the height thereof 30 cubits." Verse 3 says: "And the porch before the mouth or door of the temple of the house 20 cubits was the length before the face of the breadth of the house, 10 cubits the breadth before the face (or door) of the house." Verse 17 says: "And 40 cubits was the house, that is to say, *hua*, the temple, before its face (or door)."

There is, then the *house*, *bayith*, 60 cubits; the *temple*, *hecal*, 40 cubits; and the length of the *porch*, *olaum*, 20 cubits, one length connected with another, for the ground plan, or a total of 120 cubits. This gives, or embraces, in the *house* and *temple* inclosure, the length of the *tabernacle* and *court* inclosure, of 100 cubits. As to the *porch*, *olaum*, in front of the temple, II. Chronicles, chapter 3, verse 4, says: "And the porch that was in the front, the length was according to (or agreeing with) the breadth of the house, and the height was an hundred and twenty (120) cubits, and he overlaid it within with pure gold." Here, it is observable that the holy of holies was lined with gold; it was at the extreme end of the length of 120 cubits. Here, *the base of the porch*, or bottom of a height of 120 cubits, of the same dimensions as to the length, and one-half the width of the most holy place, is also lined with gold, going to show what the connection of these gold-lined rooms had to do with the distance of 120 cubits. Josephus says there was a superstructure above the house equal to it in height ($30 \times 2 = 60$) and then doubled, making a total height of 120 cubits.

What the inclosure of the *temple*, *hecal*, part was, as distinguished from the *house*, *bayith*, is not specified; but it is simply stated that the *door of the house* opened into the *temple part*, and the *door of the temple part* into that of *the porch*. It may have been an intermediate court like the court of 60 cubits before the tabernacle structure; the difference not being in the sum of the lengths, which, in either case, was $40+60=100$ cubits, but in the one case the court is 40, and in the other 60 cubits long. The temple, likely, was a court looking to the open vault of the heavens, and surrounded by other inclosures? But what became of the altar of incense? Of the table for shew bread? Of that for the golden candlestick? These supposed to be placed in the most holy place before the veil, as in the tabernacle, then the only further change of arrangement seems to have been simply in the location of the *brazen sea* in the northeast corner of the house inclosure, part of the court before the tabernacle, now, or here, placed under roof; the great brazen altar being located before the house in the temple part. II. Kings 16, 14, mentions this as in the forefront of the house, and this is again implied in I. Kings 8, 64. It could not be located within the house, as there would be no space around it. This fact of its being before the house, gives a distance between the house and the porch, as the temple part. I. Kings 6, says that there were *two pillars*—*Jachin*, which, according to Josephus, was on the south side, and *Boaz*, which was on the north side of the porch entrance. They were 18 cubits in height each, or, together, 36 cubits, or the 1-10 of 360°; and they girded 12 cubits.

The *holy of holies* was a cube of 20 x 20 x 20 cubits, located, as stated, in the west end of the house, *bayith*. Five colors seemed to be involved about and in it. It was, according to Josephus, built in *white*, or the color of the *ether*. Inside it was lined with *red* cedar. This again, was lined with *orange* gold. The interior was closed against the light, and was in the blackness of darkness, as the proper place for the ark of the covenant (or the meeting together of two opposite principles). It is thought that these colors typical—*red*, earth; *golden*, of the sun in general, or the sunny part of the year, when, or as, contrasted with the brazen sun of winter; *white*, or *silver color*, of the moon; and *black*, of the night, of the *womb*, of the nadir. The condition of the room as to colors would seem to indicate *time* and *earth* measures, and also the place where those earth measures were to be found, or to be originated, as down in the depths at the center of a mass, in the dark; like finding a starting point of construction by placing a pyramid in a sphere.

(b.) The holy of holies was divided, as to its cubical contents, by the placing of the *cherubims*. There seems to be no especial meaning to this word, fitting it for such a place. The meanings usually assigned, though perhaps proper enough after a fashion as *man*, *angel*, *cherub*, are really not proper to the term. The word comes from *Carab*, meaning *prehensile*, to *seize*, *grasp as with talons*, or between talons; as substantive, it means *a bird* (as a griffin or eagle), fierce, because of its quality of closing upon something, or anything, with its talons. It is the English word *crab*, that seizes with its circular pincers; also the word *grab*, as closing the fingers upon something. On looking at the Zodiac signs for *June* and *October*, it will be seen that they are represented as closely alike—one as the *scorpion*, and the other as the *crab;* and, in fact, for the zodiac, these two answered, as stretching over or embracing the two cubes representing that quadrant of the year between *cancer* and *scorpio*, just as the *cherubims* stretched over and embraced the *covenant* or *meeting* of the two halves of the ark. This word is especially used as to the Garden of Eden, guarding the way to the tree of life in the center of the space, the *place of covenant* or of *meeting*. In one sense, they may be taken as the *hooks* barring the opening of the *sistrum*. It is used as spanning half the space over the ark of the covenant; and the same use is here made as for one spanning half the space over 10 cubits. The real value of the word is thought to be *in its numerical value*, which is

Caph = 20, *Resh* = 200, *Beth* = 2, or a total of 222. These cherubims were 10 cubits in height, and stood with outstretched wings of 5 cubits in length, each touching as to each, the wall upon one side, and the tip of the wing of the other, in the midst. Underneath the meeting or covenant of the wings was the division line, either of separation or of meeting of the two rectangular solids of the ark of the covenant (signifying the two sexes).

Comparison of the Measures of the Temple with those of the Great Pyramid.

(c.) (1.) As to the *pillars*. 18 cubits = 20.612 + 10.306 feet, or 30.918 feet; and these are the numerical values, divided by 10, to give the standard measures of the vertical axial line of the pyramid, to embrace the distance between the top of Campbell's chamber and the base of the pyramid, and between the base and subterranean (floor of) passageway. $30.918 \div \frac{10}{12} = 25.765$, and 1-2 the length of the ark is 25.765 *inches*. The girth of the pillars was 12 cubits = 20.612 feet, showing that the circumference was in terms of a perfect circumference value. Whether the sum of the heights, or 36, was to represent a reduction of the circle of 360°, is a matter of conjecture; but it is strengthened by the fact that *Boaz* was the representative of Typhon, or the *North*, or the dark or winter part of the year, and *Jachin* was the opposite, and as a division of the standard circle of 360°, each would indicate *the half*, or 180°: and *they are each noted as* 18. If the conjecture is right, one entered the temple the gateway of the *birth* of the year circle. This is perfectly paralleled by the qualities of the descending passageway in the pyramid, as it involved both the circular elements and their application to the measures of the earth in its equatorial value of 360°, by its diameters in miles, and then the measures of the time circles about the sun made by this very equatorial.

(2.) The *porch* was 120 cubits high, or 206.12 feet, that so familiar value of the pyramid. It was 20 cubits long, or 34.3533 + feet, or the standard length of the king's chamber in the pyramid. It was 10 cubits broad, 17.1766 + *feet*, 206.12 *inches*, the standard width of the king's chamber

(3.) The *porch*, *temple*, and *house* lengths, together, were 120 cubits, or 206.12 feet, also; while the *holy of holies* plus the most holy place, or 40 cubits in all, or 68.7064 feet, was, as to measure, and comparative location, the veritable measure of the king's chamber *region*, with respect to its like location in the 120 cubit height in the pyramid.

(4.) The *temple* and *house* lengths, together, or 60 + 40 = 100 cubits = 171.766 + feet, or 2061.2 inches, was that beautiful proportion, as extending from the base of the pyramid to the center point of the king's chamber *region*. From the base of the pyramid to the roof of Campbell's chamber is 137.509 + 68.7066 = 206.12 feet, or 120 cubits (taken at the standard measures). The king's chamber region taken from a point in the center of the floor, with a radius of 34.3533 + feet, 68.706 feet, or 20 x 2 = 40 cubits. There can be no mistake as to the sameness of intention as regards these like measures. (The value 206.12 feet, or 120 cubits, was a great governing measure, and as it implied also the full numerical value 20612, being constructed from it, it was the great number value, after all, of all construction, as is fully set forth in the foregoing sections of this work. This number of 120 cubits, then, thus composed, is 206, and its use thus, and in its original term of 20612, is implied in the great measuring *word* throughout Scripture and Kabbala. That word is *Dabvar*, in Hebrew, or 206, and is the *Logos* word.)

(5.) The *holy of holies*, as a cube of 20, was just 1-8 of the cube of the king's chamber region in the pyramid, or the full cube of the length of the king's chamber. (This use, emblematically, is referred to elsewhere; but it is of so curious a nature that it is well to state it again. The primal *one*, or *cube*, was taken as containing all material and all life within itself. It was male-*female;* but when disintegration took place of the *one* into *two* separated and opposed existences, as of *male* and *female*, each had to be a perfect *one*, also, in its special construction. To make, therefore, a *perfect one*, which will combine these opposed relations, they were to be used together, and it requires just 8 of the smaller cubes, *viz.*, 4 males and 4 females, together to make the larger. The king's chamber *region* is the great cube of this union; and the king's chamber, as to its length of 20 cubits, was the eighth part of the whole cube, and, of itself, was, as to its length, an oblong of *two cubes*, or, in itself, male-female.) The division by the cherubims divided into halves, making a nearer approximation to the king's chamber proportions. The ark, though similarly a small rectangular solid or oblong, placed in the holy of holies, as the coffer was in the king's chamber, was differently proportioned, showing a difference of use in the measurement.

(6.) As to colors, the *white* and *red*, and *black* of the temple tallied with the like of the pyramid, the golden being an exception. (And, *possibly* that exception would not have been noted, in the palmy days of its practical use).

(7.) As to the *ark*, it was 2 1-2 cubits long, or 51.53 *inches*, or, numerically, the area of the circle inscribed in the square of 6561. Its height added to its breadth = 3 cubits, or 5.153 *feet;* showing, for one thing, that it was so contrived as to be reducible back to the elements whence its, and all the temple measures were derived; and this could not be done by possibility, except by the intervention of two grades of measure, and those were, respectfully, the English *inch* and foot.

(8.) But the sameness of relations of the temple with those of the pyramid seems to be confirmed by the use of the *cherubims*. They were 10 cubits high, and by their use marked out the division of the holy of holies into 10 cubits measures. Take some pyramid developments:

(1.) $5153 \times 8 = 41224$ *inches*, the circumference of the base of the pyramid placed in the sphere.

(2.) $5153 \times 2 = 20612$; $\frac{206.12}{12} = 17.17666$ feet, or 10 cubits. $17.17666 \times \frac{4^2}{3^2} = 3053+$ feet, or 36643.55 inches, or the circumference of the base of the pyramid proper; 1-8 this circumference is $381.7037+$ feet, or,

$222.222+$ cubits.

It is thus seen that the use of the 10 cubits value develops the 1-2 base side of the Great Pyramid in the measure of 222 cubits. It is seen that in the development of the holy of holies, the ark contains the original measures. It is placed in a space of 10 cubits. This 10 cubits measure of division is made by the use of the (Hebrew word) *cherub*, and the numerical value of *cherub* is 222.

(Sec. 53.) There is a most strange and far-reaching value connected with this cubit value of 444.444 for the base side of the pyramid. The four sides would equal $1777.777+$ cubits. The pyramid was constructed from that value of the Parker elements of $20612 \times \frac{4^2}{3^2} = 36643.55+$ for circumference value, and $6561 \times \frac{4^2}{3^2} = 11664$ for diameter value, or for height. Now,

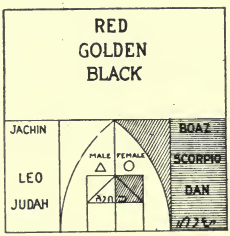
(1.) $36643.55 \div 20.612 = 1777.77$, and

(2.) $11664 \div 6.561 = 1777.77$; or, numerically, this very pyramid base value. This is brought about by the factor $\frac{4^2}{3^2}$ as common to both. $\frac{4^2}{3^2} = \frac{16}{9}$; and, as was shown, this expression embraces the factors of the square foot English, because $16 \times 9 = 144$. The reverse use or $16 \div 9 = 1777.777+$, showing that these factor numbers, by another change of use, at once lay the foundation of the pyramid and temple works; the knowledge of the scales of measure, and the use as applied to geometrical elements, being implied. Somehow, all the systems—*Hindu*, *Egyptian*, *Hebrew*, and

British—belong to one another, and are, in fact, one system.

So, here in this temple and its holy of holies, and its ark, we have the ear-marks of the full use of the pyramid measures, under another style of architecture. Was there ever such a concordance of measures, unless attended by a similarity of use?

(d.) The representation of the holy of holies, in vertical cross section is as follows:



The ark was the residence of Jehovah, and he specifies his place as at the meeting of the cubes of the ark, between the cherubims. What was his numerical essential, to accord with all these measuring properties? He was the perfect *one*, or 1—0, or a straight line, *one*, of a denomination of the perfect circle, 0—*viz.*, 20612; reduced evenly and by scale, to an inappreciable minuteness, *not to be seen by the eye*, *nor conceivable by the senses*, *yet*, *nevertheless*, *this perfect one.*

KABBALISTIC MATTERS CONNECTED WITH THE TEMPLE DESCRIPTION.

(e.) The astronomical features about the temple were plain. The entrance was toward the rising sun, or the *vernal equinox*. The holy of holies was in the *west* of the structure, toward the place of the *setting sun*, the *autumnal equinox*. The great quadrangular was oriented and faced to the *four winds*, or N., E., S., and W. The brazen sea had on its ledges the ox, the cherub or man, and the lion. The lion was the sign of the *summer*, the man of the *winter* and the ox of the *spring*. The sign of autumn, or Dan, was left out—that worm all-devouring, never-dying, the scorpion. This has an architectural parallel. Nork relates that the temple of *Notre Dame*, in Paris, was formerly a temple of the goddess *Isis*, or the sign *Virgo*. On this temple was sculptured the zodiac with its signs; that of Virgo (*Isis*) was left out, because the whole temple was dedicated to her. So with the temple. The whole religious cultus of the Israelites was located in the sign *Dan*, or *Scorpio*, for it was here that "I have waited for thy salvation, O Lord (*Jehovah*)." Take the two squares of the zodiac, representing two quarters, or quadrants, of the year; one lorded over by Leo, the lion, next to the summer solstice, and then going west and downward, the second quadrant is reached, extending to the winter solstice, and lorded over by Dan, the scorpion, who holds the entrance. This upper square, or cube, is *golden*, the male, full of the fructifying power of the sun; the lower one is the female, and black, the womb, *the brazen* part. Now it will be seen that Solomon, the son of David, of the tribe of Judah, whose sign was the lion, made all the *gold work*. But it was Huram that made tne *brazen sea* and all the *brass work*. Who was Huram? The son of a widow, a woman of dark or black weeds, of the tribe of Dan, whose sign was the Scorpion. He made the work pertaining to his portion of the zodiac—that is, the place of Typhon, of winter, of darkness, of woman, etc. So, here is represented the western half, and the summer and winter quarters of the celestial sphere, squared, or cubed.

There is something peculiar as to the opening of the 6th Chapter of I. Kings: "And it came to pass, in the four hundred and eightieth year after the children of Isreal were come out of the land of Egypt, in the fourth year of Solomon's reign over Israel in the month Zif, which is the second month, that he began to build the house of (*Jehovah*) the Lord." The chronological date here pointed out has been a very great vexation and stumbling-block to commentators. It is generally looked on as a date falsely taken. But it is well enough a determination of the meaning of the structure which was about to be built, for $480 + 4 + 2 = 486$, which, in feet, as coming from $6561 \times \frac{16}{9} = 11664$ inches, was the height of the great pyramid, or sun measure, the interior works of which were copied after in the temple, as has been shown.

QUADRATURE OF THE CIRCLE, AND SQUARE ROOT OF TWO.

By W. A. Myers.

(Sec. 54.) Of Melchizedek (Pater-Sadic), Hebrew learning has handed down that he was without *beginning or ending of days*. *True*, but he was a means also of determining both by correction, holding the balance of the ecliptic. (As to the value of Melchizedek of 294, this is 49×6; and as to the number 49, or 7^2, attention is called to "Proposition 2, Theorem," and to "Proposition 3, Theorem," of a "Quadrature of the Circle," and "The Square Root of Two" by W. A. Myers, of Louisville, Ky. (Wilstach, Baldwin & Co., Cincinnati.) It may be that Mr. Myers has reproduced an ancient method for the calculations of circular elements as sines, cosines, etc. His Proposition 3 is as follows:

"(1.) If a circle be described with the square root of two for a radius, and the *one-fiftieth* of the square described on the radius be deducted therefrom, the square root of the remaining *forty-nine fiftieths* can be extracted exactly. (2.) The square root of the *one-fiftieth* so deducted will be the sine of the given arc. (3.) The square root of the remaining *forty-nine fiftieths* will be the cosine of the given arc." In many respects his work is well worth mention

NOTE AS TO FISHES.

From *The Source of Measures*.

By J. Ralston Skinner.

(Sec. 55.) "The symbol of the '*fish*' was a favorite one among all the ancients. Mr. Bryant shows its origin, in the mythologies, to have been in the figure of the Deluge; the type being of a fish with the *head of a man*. In Phœnicia, especially, it was of great import in the idol *Dagon*. The Christian Kabbala, or Gnosticism, deals very largely in the mention of fishes; in such sort, that it may be said to be rested upon the symbol, though its use everywhere is made to appear as *incidental* and natural. The New Testament narratives have been so highly colored by the kabbalistic import, that, commonly, too sweeping or embracing a quality has been given to the idea of fishermen, as applied to the apostles. The character of *fishermen*, it is true, is attached to Peter and Andrew, to John and James; but, beyond the little that is said of their catching fish with nets in boats, no great stress is laid on *fishing* as a *trade*, or fixed occupation. There was sufficient to introduce the use of the ancient symbol, without departing from what might truthfully have been the case as to fishing in the Jordan. The fishing as conducted by these men, was in the Sea of Galilee, or of Tiberius. This, lake or sea, is but an enlargement of the river Jordan, where it spreads out into wide water, or small lake, or rather pond, of some ten to twelve miles in length by about six miles in breadth. The fishing carried on in it was in ships, or small fishing vessels, with sails, by means of seines or nets. The population to be supplied was a dense one at that time, and the occupation is represented as pertaining to quite a class, thus exhibiting a settled business. It seems impossible that this could have been the case. The only condition by which fishing of that kind could have existed, and could have been carried on as a trade, in such a piece of water, would have had to depend upon a constant supply of fish to catch, from some large body of water as a breeding ground, the fishing taking place in what is called the *run of the fish*, at stated seasons. Communication with such a body of water—as, for instance, the ocean—would stock such a pond with a few fish at all times, but not in such quantity as to justify an occupation as described, save at certain seasons of the year. This is a simple and truthful statement, justified by all the registered experience in such matters. But the conditions of the Jordan river are fearful for sustaining fleets of fishing vessels plying the trade on the waters of the sea, or pond, of Tiberius. It is almost a straight stream, with a very rapid descent from its source to its mouth (it is called The Descender), save when it enlarges out in the morass of Merom and into the waters of this inland sea. Its condition parts of the year is that of a brook. It rises in the springs of Mount Hermon, and, after a run down hill of 150 miles, empties into the asphaltum lake, in which no fish can live or *breed*. If the river was far enough north, brook trout might abound to some extent in its waters, but these would have to be preserved with care, for it would require but little angling to depopulate it of this species. The whole of the fisheries of the Sea of Galilee would, therefore, have to depend upon its own breeding-grounds, of which, it may be said, there can be none, save of the species of what are called mud or cat fish, which were prohibited from use, as having no scales, and a few others, utterly unfit to found a fishery on, as a business of continuous calling. The conclusion seems irresistible, that to have supported a mode of fishing, such as is commonly thought and taken to have been the case, would have required a continuous miracle of keeping up the supply. All this seems to confirm the idea that the relation of *fishing* was to raise a symbol, comporting with and necessary to display ancient uses and meanings."

(Sec. 56.) As is seen, the great display of the creative *law of measure* among the Egyptians was in the "*first great wonder of the world*," the great pyramid. Among the

Hebrews it was in (1.) the Garden of Eden; (2.) the Ark of Noah; (3.) the Tabernacle; and (4.) the Temple of Solomon. Around these actual displays, descriptions were conveyed by the hieroglyphic reading of the narratives of Holy Writ. "Woe be to the man who says that the Doctrine delivers common stories and daily words! For if this were so, then we also in our time could compose a doctrine in daily words which would deserve far more praise. If it delivered usual words, then we should only have to follow the law-givers of the earth, among whom we find far loftier words to compose a *doctrine*. Therefore we must not believe that every word of the doctrine contains in it a loftier sense and a higher meaning. The narratives of the doctrine are its cloak. The simple look only at the garment—that is, upon the narrative of the Doctrine; more they know not. The instructed, however, see not merely the cloak, but what the cloak covers." (The Sohar, III., 152; Franck 119.)

THE ESOTERIC TEACHING CONFINED TO THE FEW

(Sec. 57.) The author believes that no man can study the Bible a great while, carefully and dispassionately noting its place in the world, its surroundings, its handings down, its prophetical bearings, not considered in detail, but in their large and comprehensive scope, without coming to the conviction that a Divine power and providence doth in some way or sort hedge it about, and without coming to the conviction that this Divine Power is a conscious entity, just as we are; that he is, by his superiority, wisdom, and power, continually and everywhere, intelligently present as the *immediate cause* of each sequence in all the universe, however minute. (Not working by positive fixed laws of construction, which, once enacted, the work can forever go on, without any immediate supervision of the Master, a postulate so commonly assumed; for it is observable, where investigation can reach, that while *every type* of work seems to be under a *general type law*, yet every *indivi-*

dual production under a type is clearly enough seen to be *a variation* upon every other individual, thereby necessitating the actual intervention of creative power for every individual created under such a law.) He who considers that man alone is the only phenomenon in all the wide universe of a conscious intelligence, as concreted from an infinite number of blind happenings or accidents, arrogates very much to the superiority of his accidental position, especially when he takes into view his own acknowledged littleness and inferiority; for he that can make nothing is yet superior to the blind working of the elements to which he is indebted for himself, which elements come under the general term of *God* or *Nature*. What a picture of self-sufficiency! The conscious entity, *man*, simply proves series after series of such a class of entities, graded upward, past man's power of recognition. Man's *ego*, as connected, even, say inseparably with his body, is just that phenomenon of nature that implies an *ego* function of nature herself, as inseparably connected with grosser material than that function. The only question is as to whether, in man, or otherwise, this function can shed its covering for another; or whether, in fact, he may have two kinds of material body, one of which may continue, the other perishing.

But apart from this, and as to the Bible this being said, there are, nevertheless, some strange features connected with its promulgation and condition. Those who compiled this Book were men as we are. They knew, saw, handled, and realized, through the key measure, the *law* of the living ever-active God. They needed no faith that he was, that he worked, planned, and accomplished, as a mighty mechanic and architect. What was it then, that reserved to them alone this knowledge, while, first, as men of God, and second, as apostles of Jesus the Christ, they doled out a blinding ritual service, and an empty teaching of *faith*, and no substance as proof, properly coming through the exercise of just those senses which the Deity has given all men as the essential means of obtaining any right understanding?

Mystery and *parable* and *dark saying* and *cloaking* of the true meanings are the burdens of the Testaments, Old and New. Take it that the narratives of the Bible were purposed inventions to deceive the ignorant masses, even while enforcing a most perfect code of moral obligations: How is it possible to justify so great frauds, as part of a Divine economy, when to that economy the attribute of simple and perfect *truthfulness* must, in the nature of things, be ascribed? What has, or what by possibility ought mystery to have, with the promulgation of the truths of God?

ARE THE KEYS OF THIS ESOTERICISM LOST?

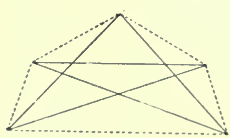
(Sec. 58.) Men like ourselves, who were capable of teaching the multitudes, held this knowledge, both in the times of the Old and New Testament. If at all, when was this knowledge lost? There is witness, by the emblems remaining in use, that *two modern bodies* have at one time been in possession of the keys—*viz.*, (1.) that order called the Roman Catholic Church, which *is catholic* to the extent of possession of the emblems of the universal knowledge, which was confounded by the confusion of *lip*, and which possession has been dropped by all sects, creeds, etc., which have dropped the consideration of the "basic knowledge" or *dabvar;* and (2.) that body of men called *Free Masons*. It is probable that the Greek Church, and the Brahmin system also, come under this category. The elimination of the vestiges of the workings by the key system can even be seen in the English Church; for one of the great functions of the church was to regulate the order and times of its holidays. This was done agreeably to the passage of the sun in his circuits through the signs; but in the preparation of the order of service, as it is to be seen on the original rolls (see fac-simile of the *Black Letter* Prayer Book, made in 1663, as taken from the original rolls or scrolls in the British Archives), it was deemed, for some reason, best to wipe out these calendars teaching the progress of the sun through his signs. (There is but little doubt that the rules for the calculation of tables of time, to mark the proper observance of religious festivals, which tables are prefixed to the Book of Common Prayer, are precisely the same to be found in the first chapters of Genesis, relating to the founding the year values on *lunar tables*. Christianity is almost undoubtedly indebted to the ancient Jewish and Egyptian calendar rules, on which she built up the special exceptional details of her own forms.)

Mr. J. R. Skinner, at the close of his work, "The Source of Measures" states:

(Sec. 59.) "One of the most remarkable proofs of the existence of this knowledge (of the foundation of these mysteries on the Parker and Metius relations of circumference to diameter of a circle) down to a very late day, lays, as it would seem, in the resolutions passed by those two learned bodies of men, the Academy of Sciences at Paris and the Royal Society of London. (See Parker's Quadrature.) It was in the period of the revival of knowledge, when the world, possessed of extraordinary intellects and wholly athirst for learning, was investigating every cranny and department of nature. All recognized the fact that in nature one of the most interesting relations was that of circular to plane shape, and the flux of one into the other. Ordinarily, in matters of research, promising great rewards, none so persistently encouraging of interminable effort in the pursuit of the obscure realms of science as these bodies. What was the reason, then, that on the production by Legendre of his acknowledgedly approximate value of *pi*, the Academy of Sciences passed that famous resolution that it would never entertain any thesis on the subject of the quadrature of the circle? What was the reason that, in a few years afterward, upon Playfair's following in the footsteps of Legendre, the Royal Society of London passed, perhaps, a copy of the same resolutions? Since that time, every man daring to venture into that forbidden field of research has been, by a mysterious common consent hooted down, laughed at, and derided, by the manifestations of a mocking false piety; and just in the measure that his works have proved valuable, just in that measure has the effort been strong to remove them from the study of the people. Now it is barely possible that the keys of these old mysteries are still known and held by very few; that these few are recognized by the very highest of the order, so that an order to that effect of procurement of just such a piece of chicanery as that practiced by these societies, once promulgated, would be obeyed and carried into effect willingly, and even zealously, by multitudes of those who might remain in perfect ignorance as to the source of the order or as to its real object.

"*There are, moreover, two evidences of the modern existence of this knowledge in symbolism.*

(1.) "In 'The Gnostic,' Plate VI., 1, is to be found a Templar or Rosicrucian emblem. It is of that '*Idol*' or '*old man*,' a worship of which was charged against the Templars. It is an *old man*, with his arms *crossed* in front. At his feet, on one side, is a *celestial globe*, with its subdivisions and on the other side the *pentapla*, or five pointed star, or *seal* of Solomon. Here are displayed the *man*, 113, or diameter value to a circumference of 355, or the *Hebrew man*, *the celestial circle*, and the *pyramid*. The *pentapla*, as it is drawn, is but the lined display of a pyramid. It is a pentagon, as well as a rayed star. Retain the rays, and then join the corners by lines, and the object of setting forth a pyramid is at once apparent. The pyramid involves



all the measures, with the purposes thereof enumerated in the text; so the whole of this picture symbol, though modern in its use, really displays the possession of the keys of the ancient knowledge in a most masterly manner.

(2.) In "*Land-Marks of Free Masonry*," by Oliver, is to be found a frontispiece, which, for magnificence of conception and for comprehensiveness of grasp, is most remarkable. "It is said to contain the symbolization of the *genius* of free masonry, and is said to have been designed by Bro. Com. J. Harris, P. M. and P. Z. The author ventures to state positively that if this was really designed by this gentleman—that is, if he did not compile it from simply traditionary sources—then, indeed, *he must have been* acquainted with the elements of the quadrature as John A. Parker has, since that time, set them forth, their astronomical application in architecture, and their Biblical containment, in a fashion of such wisdom that if the author had possessed it in its details, his efforts in this work could have been relieved of suggestion. The reading of this frontispiece by its symbols, even with the imperfect ability of the author, is always a source of exquisite delight and unalloyed amazement. The representation is in a rectangular oblong of *two* squares. At the center of the top line there is located the triple circle, or three circles, one within the other, with an inclosed triangle. In the triangle is written the great name (*Jehovah*). It exhibits the *origin of measures*, in the form of the straight line *one*, of a denomination of 20612, the only numerical value of the perfect circle, the straight line being male and the circle female; which 20612 is the *Logos*, or *Dabvar*, or *Word*. The triangle and circles indicate the pyramid containing the use of the measures, with the three sets of circular elements necessary to the display of its various problems. This emblem is in an effulgence of light, above the brightness of the sun, and the *One* of the word is the holy 10, and circumference to 318, the Gnostic value of Christ, whence this spiritual effulgence. From this upper essence of effulgence, a strong bar of light descends obliquely to the foot of the oblong. On the one side of this all is darkness, and chaos, and confusion, containing darkness and dragons, and all deeps. It is the *female* or *sin* side. At the foot of the oblong is a pavement of squared blocks, in cubes, alternating in black and white chequers, indicating the female and male elements of construction; and on the dark side, this pavement is not made, but is in confusion. At the foot on the dark side, stands a little cherub, striving to work out one of these pavement cubes from a rough block or ashler, but without success. He stands holding his chisel and hammer in a helpless sort of way, as if having a dim idea of what is wanted, but as lacking in the requisite knowledge for elaboration. The other side of the bar of light is bathed in the essence of wisdom and peace. On this side the foot has a completed pavement of the black and white chequers, of a general oval, indicating the measure of the surface of the earth. Just opposite the discontented cherub is seated another, but on the light side. He is looking with a pleased expression at his brother in the obscurity. His right arm is raised, and he is pointing with his *forefinger*, the rest of his hand being closed, aloft up the bar of light to its source. This forefinger thus pointing is the symbol of the Hebrew jod, or Jehovah, or the number 10, whose origin is in the male-female word *Jehovah*, significant of the same number as emanating from the Deity name in the triangle above. His left arm is thrown over as embracing two parallel upright bars, inclosing a circle in the square, the measures of which have been revealed to man from above. The parallel bars are supported on a cube, which is one of the cubes of the pavement raised out of its place to the level of the floor, and the upright bars are but the extension of the sides of the cube. This is the cubical stone, and the square of the bars is 6561, and the value of the circle is 5153. The reading is instruction on the part of the enlightened cherub to his brother, telling him that from the geometrical elements, with the *least one* of a denomination of 20612, located aloft, as the *law of the Deity*, the measures of work have been revealed to man, and are under his control, as exhibited in the circle, the square, and the cube; that with these measures the cubical blocks measuring the earth are to be formed. In this is the lesson. The oblong then contains the sun and the moon and the stars as further being measurable by man through this knowledge. In the center of the piece there flies or hovers a female, as the *genius* of the whole. Her badge is on her forehead, and it is the pentapla, or five rayed star, denoting, as shown above, *the pyramid* as the containment of all measures. The moon, with the seven planets, represent the Garden of Eden woman while the sun denotes the issuance of lunar measures in terms of solar.

"All this condition of things goes to show that the mystery held, as not to be thrown open to the people, but to be retained as the property of a class, and a caste, in the more ancient days, may never have passed away; but, to the contrary, may even exist today, dominating the souls of men, women, and children, by keeping them in perpetual ignorance, and in religious feeding them on the worn-out husks of faith, without any relief, by way of setting forth actual connections between man and the Deity."

THE PROVINCE OF RITUALISM.

(Sec. 60.) "How plainly can now be seen the origin or source and reason of *ritualism*. Ritualism was not an empty thing. The adoration of the Deity was simply a constant reminder of man's dependence upon, connection with, and knowledge of Him. The worship, then, was, the expression under this or that form, by gesture, action, signs, voice, dress, accompanied by visible symbols of some one or more of the exact mathematical formulations, or geometrical formulations, or numerical combinations, pertaining to the known method of measuring the works of the Deity." A conclusion of Sir William Drummond in Edipus Judicus indirectly favors this view: "The priests of Egypt and of Chaldea," he says, "had made a progress in the science of astronomy which will be found more astonishing the more it is examined. Their cycles were calculated with extraordinary precision, and their knowledge of the most important parts of astronomy must appear evident to all who candidly consider the question. But the people appear to have been purposely left in gross ignorance on this subject. Their vague and their rural years were neither of them correct. The festivals were fixed according to calendars made for the people, and the religious institutions were only calculated to confirm the errors of the ignorant. *The truths of science were the arcana of the priests*," because they were the sources of religious cultus.

Thus ritualism was an intelligible rite, one to be understood in all its parts and ramifications; one in which there was no possible deception as to the use of a symbol, to those who *could read the symbol.* No danger then or at that time, of paying a worship to the thing. A carpenter might as easily be taught to fall down before the instruments by which he copied the sums of his Father in heaven. Intrinsically, one would be as silly and fruitless of good results as the other. It has been the gradual and finally almost perfect extinguishment of the knowledge of the origin of ritualism on the part of the *priests themselves* that has entailed a superstitious use on the part of the laity. On the other hand, Free Masonry holds to the elemental working by *geometrical* display—*i. e.*, by the *harder*, *more exact* and *purer* outlines of the same system of problems. As between the two systems, *in their ultimate*, *there is no difference at all.* Lord God of a common humanity! loosen the shackles from the bodies and enlarge the souls of men. Let freedom be the seed, and let wisdom, love, peace—but above and before all, *charity*—be the harvest. And

SO MOTE IT BE.

THE CHRISTIAN ERA.

The commencement of the Christian Era is the 1st of January in the 4th year of the 194th Olympiad, the 753d from the foundation of Rome, and the 4713th of the Julian period. It is usually supposed to begin with the birth of Christ, but the opinions with regard to his birth are various. The generally accepted opinion is that his birth took place three years and seven days before the first day of the Christian Era.

The observance of the 25th of December in commemoration of the birth of Christ, is ascribed to Julius, bishop of Rome, A. D. 337-352. The Eastern Church had previously observed the 6th of January in commemoration of the birth and baptism of Christ.

The year of the birth of Christ, according to different authorities, is as follows:

Benedictine Authors of *L'Art de Verifier les Dates*	B. C.	7
Kepler, Pagi, Dodwell, etc		6
Chrysostom, Hales, Blair, Clinton, etc		5
Sulpicius (Sacred History) and Usher	Dec.	25, 4
Clemens, Irenæus and Cassiodorus		3
Eusebius, Jerome, Epiphanius, Orosius, Scaliger, etc		2
Chron. Alex., Tertulian, Dionysius, Luther, etc		1
Norisius and Herwart	A. D.	1
Paul of Middelburg		2
Lydiat		3

MONTHS OF THE YEAR.

JANUARY—Latin, *Januarius*, is named after Janus, an ancient Italian deity, the god of the sun and the year, whom the Romans presented on the first of this month the Janual, an offering consisting of wines and fruits. The month was added to the calendar by the Emperor Numa Pompilius.

FEBRUARY—Latin, *Februarius*, is supposed to have been so named from the Februalia a feast of purification and atonement celebrated in Rome during this month. The Emperor Numa added it to the end of the year, and from this the name of the month is supposed to have been derived from an old Latin word, *fibar*, meaning the end. The decemvirs placed this month after January in the year 452 B. C.

MARCH—Latin, *Martius*. The name is derived from Mars, the god of War. March was the first month of the year in the old Roman calendar.

APRIL—Latin, *Aprilis*. The word is from *aperire*, to open, refering to the opening of the buds during this month.

MAY—Latin, *Maius*, from a word which signifies to grow, so named in honor of the goddess Maia, daughter of Atlas, and mother of Mercury, by Jupiter.

JUNE by some is said to have been derived from *juniores*, the young men, to whom Romulus is said to have assigned it; by others from Juno; by others from Junius Brutus, the first consul, and by others from *jungo*, to join, with reference to the union of the Romans and Sabines.

JULY—this month was originally called *Quintilius*, the fifth, it being the fifth month of the old Roman calendar. It was named Julius in honor of Julius Cæsar.

AUGUST—this month was originally called *Sextilis*, the sixth, and was named in honor of the Emperor Augustus.

SEPTEMBER is from the Latin *septem*, seven.

OCTOBER is from the Latin *octo*, eight.

NOVEMBER is from the Latin *novem*, nine.

DECEMBER is from the Latin *decem*, ten.

DAYS OF THE WEEK.

ROMAN.	SAXON.	ENGLISH.
Dies Solis—Day of the Sun	Sunnandaeg—Day of the Sun	Sunday.
Dies Lunæ—Day of the Moon	Monandaeg—Day of the Moon	Monday.
Dies Martis—Day of Mars	Tuesdaeg—Day of Tuisco	Tuesday.
Dies Mercurii—Day of Mercury	Wodensdaeg—Day of Woden	Wednesday.
Dies Jovis—Day of Jupiter	Thorsdaeg—Day of Thor	Thursday.
Dies Veneris—Day of Venus	Frigadaeg—Day of Friga	Friday.
Dies Saturni—Day of Saturn	Saterdaeg—Day of Sator	Saturday.

An Astronomical Day commences at noon, and is counted from the first to the twenty-fourth hour.

A Civil Day commences at midnight, and is counted from the first to the twelfth hour, from which time the count is repeated.

A Nautical Day is counted as a civil day, but commences like an astronomical day, at noon.

A Solar Day is measured by the rotation of the earth upon its axis, and is of different lengths, owing to the ellipticity of the earth's orbit and other causes. A mean solar day is twenty-four hours long.

HISTORY OF THE INTERIOR OF THE PYRAMID.

PART III.

(Sec. 61.) There is little enough of hollow interior space to enter into, in any of the Egyptian Pyramids, as they are generally all but solid masses of masonry. And yet what very little there is, will be found quite characteristic enough to raise up a most radical distinction of kind, as well as degree, between the Great Pyramid and every other monument, large or small, pyramidal or otherwise, in all the continent of Africa, and Asia as well.

The progress of historical knowledge, with regard to what constituted the hollow interior of the Great Pyramid, from the earliest times down, not only to Greek and Roman eras, but to this enlightened day and date (1907) has been both slow and peculiar. Had we now before us in one meridianal section of the monument, all that is now publically known and arrived at, the tale would amount to little more than this—(1.) that when the Great Pyramid stood on the Jeezeh hill in the primeval age of the world in white masonry, unassailed; a simple, apparantly solid, crystalline shape, with the secret of its inner nature untouched. Clothed completely on every side, with its bevelled sheet of polished casing stones, the whole structure rising from a duly levelled area of also white rock surface in four grand triangular flanks up to a single pointed summit. This *is the sum total* of all that was *positively* known about this "first great wonder of the world" down to the spring of the year 820 A. D., (*all other authorities to the contrary notwithstanding*) by the present race of people; when the Egyptian Caliph Al Mamoun forced his passageway into the north side of the pyramid, and *thereby* accidentally discovered the *present way* of entering that *world renowned* structure.

(2.) The author *does not* desire to intimate that *Al Mamoun*, the Egyptian Caliph, was the *first man* to enter the "great pyramid" since it was sealed up by its original builders; but that *his men*, whom he employed to force a passageway, were the *very first*, that history records as having entered this particular pyramid. In our researches, extending over 35 years, we have laid under contribution the principal authorities published on both sides of the Atlantic, and we have utterly failed to *discover* any *positive* information to the contrary of the above assertion. If any one else is known to have entered it, before 820 A. D., how did he gét in? The secret passageway (which we have hinted at) extending from (under) the Sphinx, by a circuitous course, and entered at the N. E. corner of the building, *the entrance being completely stopped with granite plugs*, has not been open to the *uninitiated* during the advent of our present race of people. Therefore, there was no possible way of entering the pyramid (known) until the hirelings of the Caliph Al Mamoun, forced the *key stone* out of the (present) entrance passage, from the inside, through his forced passage way, in the year 820 A. D. And that "key stone" as well as the *lid* to the *coffer* in the king's chamber, together with many of the (outside covering) angle stones, have been carried away into India; and possibly are now in the possession of the wealthier Maharajas of that country.

(3.) Barring the space occupied by the *forced* passageway of Caliph Al Mamoun, the following named chambers and passageways will account for all the hollow space in the interior of the great pyramid, so far as is known to the scientific world, at this date, 1907: *viz.*, *The King's Chamber*, located on the 50th layer of stone at an elevation of (about) 142.82 feet above the pavement and (about) 9.68 feet south of the verticle axis of the pyramid.

The Ante-Chamber is situated adjoining the king's chamber, on its north side, at the same elevation; the verticle axis of the pyramid forming its north boundary.

The Queen's Chamber is located on the 25th layer of stone, at an elevation of (about) 75.58 feet above the pavement, the verticle axis of the pyramid forming its south boundary line.

The Subterranean Chamber is situated (about) 100 feet below the basal plane of the pyramid (in native limestone rock), the center of which chamber is located directly under the verticle axis of the building and the floor of which is about 586 feet below the apex of the structure, as it stood in the early part of the year 820 A. D. The entrance to which is reached (at present) through the entrance on the north side of the pyramid: you descend at an angle of 26° for 340 feet to reach the subterranean chamber. The following extract from the 4th edition of "*Our Inheritance in the Great Pyramid*" by Piazzi Smyth, will thoroughly illustrate the shape, and present (and ancient) condition of this chamber; and at the same time show that Prof. Smyth did not know, or conceive, the purpose for which this chamber was originally constructed; *viz.*—"that then it contained within, or beneath its foot (trending down from the north, and entering at a point about 49 feet above the ground, near the middle of that northern side) merely an inclined descending passage of very small bore, leading to a sort of subterranean, excavated chamber in the rock, about 100 feet vertically under the center of the base of the whole built monument.

"This one subterranean chamber did really exist, in so far as it had been *begun* to be carved out, deep in the heart of the rock, with admirable skill. For the workmen, having cut their sloping way down to the necessary depth by the passage, commenced with the chamber's ceiling, making *it* exquisitely smooth, and on so large a scale as 46 feet long by 28 broad. Then sinking down the walls from its edges in verticle planes, there was every promise of their having presently, at that notable 100-foot depth inside, or rather underneath the surface of the otherwise solid limestone mountain, a rectangular hollow space, or chamber, whose walls, ceiling *and floor* should all be perfect, pattern planes. But when the said men, the original workers it must be presumed, had cut downwards from the ceiling to a depth of about 4 feet at the west end, and 13 feet at the east end, they stopped in the very midst of their occupation. A small, very small, bored passage was pushed into the rock merely a few feet further toward the south, and then that was also left unfinished; a similar abortive attempt was likewise made downwards, but with the only result, that the whole floor, from one end of the chamber to the other, was left a lamentable scene of holes, rocks, and up-and-down, fragmentary confusion. Verily, (seeing that the whole light of day was reduced down there to a mere star-like point at the upper end of the long entrance passage, nearly 340 feet long) verily, it was an answering locality for "the stones of darkness and the shadow of death." (See Plate VI. and IX.)."

Will any enthusiastic Egyptologist of this day, that has already accepted Prof. Smyth's theory of a *Deified* Architect, still believe with him, that the Subterranean Chamber, or any other portion of the pyramid, *is unfinished*, or in other words, not completed *in exactly* the way it was originally designed? *We* think not; for, when the reader broadens out to the theory—that the whole pyramid, including the Sphinx, the different passageways and *this* Subterranean Chamber, constitutes one "*grand initiatory asylum*," he will *perceive* that the *perfection* of the ceiling, and the *chaos* of the floor, represents "*the unfinished state of the temple*." This is where the *candidate* was first brought to light and received his first lesson in astronomy.

The remaining portion of the hollow or vacant space in the pyramid, is to be found in the passageway (*descending*) from the north side of the pyramid down to the subterranean chamber, 370.5 feet; the horizontal passage from the lower end of the grand gallery to the entrance of the from a point on the *descending* passage way 82 feet from the north end, to the beginning of the Grand Gallery, 128.5 feet; the Grand Gallery, *ascending*, from a point commencing at the entrance of the horizontal passage-way, to its ending at the Ante-Chamber, 156.75 feet. And then the well, 191 feet, nearly verticle, and the Grotto, an enlarged space within the well. The above mentioned points constitute about all the space *known* to exist within the Great Pyramid. The area and size of each will be given in another chapter. To the student who has followed our argument and conjectures up to this point, we would put the query: Do you *think*, or *imagine*, that the above mentioned "*hollow*" or *blank space*, or *chambers* and *passage-ways* are the *only chambers, etc.*, contained in that massive grand structure? Think of the size of it—covering as it does over 13.34 acres and about 486 feet high when it was perfectly encased in its original form, and containing over 93,060,000 cubic feet of masonry. *Unless*, some time in the future other chambers are discovered, and found to be even more spacious than those now known to the world at large, intelligent humanity will begin to query, and stand in awe! at this wonderful waste of material. It will be on a par with the heavenly bodies, *i. e.*, if we discover that this little insignificant *earth* of ours, is the only planet inhabited? The author does believe that many of the fixed stars are inhabited; and further (which will be possible to prove) that the Great Pyramid Jeezeh contains at least *three* more chambers, located between the King's Chamber and the apex and at least *one* with double the capacity of the latter. And we will now suggest their location. After the Queen's Chamber on the 25th layer of stone; and the King's Chamber at the 50th layer; we would place the next larger chamber on the 75th layer, and the *very largest* hall, or chamber on the 100th layer of masonry. This chamber should equal in capacity the other three below it. The final, or fifth chamber on the 120th course of masonry; and its size should be just one-half that of the King's

Chamber. A further explanation of the above will appear in our closing chapter.

(Sec. 62.) The records of all past history (regarding the Great Pyramid) are a unit on the "tombic subject" that "No remains of any kind of coffin *have* ever been reported to have been found in any chamber or passageway of the Great Pyramid."

There has been some scholastic question of late years as to whether Herodotus in 445 B. C., Strabo 18 A. D., Pliny 70 A. D., and others of the more mediæval ancients, or their immediate informants, were ever actually inside the Great Pyramid; for sometimes it has been maintained that the edifice was inviolably sealed, and that what they mentioned of the interior was only on the reports of tradition. All written history seems to corroborate the above statement.

That subterranean chamber, which *ought* to have been the first thing finished, according to both all ancient Egyptian ideas and the "Lepsius Law" of profane Egyptian-Pyramid building,—but was not. The very chamber which ought to have contained (if it was built for the same purpose, that all subsequent pyramids were) a real sculptured sarcophagus, mummy, paintings, and inscriptions, —but which only really held the rough, natural rock-contents of the lower part of the room, not yet cut out of the bowels of the mountain.

In short, all the classic and idolatrous nations of old (say from 1400 B. C. to 820 A. D.) knew nothing whatever about the now known real interior of the Great Pyramid's construction or purpose.

THE GREAT PYRAMID ENTERED FOR THE FIRST TIME, SINCE ITS ORIGINAL BUILDERS SEALED IT UP, THE DATE OF WHICH IS UNKNOWN.

(Sec 63.) Caliph Al Mamoun, son of Harcun Al Raschid, of the "Arabian Nights", during the early part of the year 820 A. D. with the aid of his Mohammedan workmen, has to his credit "the first to enter"(by a forced passageway) this First Great Wonder of the World. He directed his Mohammedan workmen to begin at the *middle* of the northern side; precisely, says Sir Gardner Wilkinson, "as the founders of the Great Pyramid had foreseen, when they placed the entrance, (present entrance) not in the middle of that side, but 24 feet and some inches away to the east, as well as many feet above the ground level. Hard labor, therefore, was it to these masons, quarrying with the rude instruments of that barbarous time, into stone-work as solid (almost before them) as the side of a hill.

They soon indeed began to cry out "Open that wonderful Pyramid! It could not possibly be done!" But the Caliph only replied, "I will have it most certainly done." So his followers perforce had to quarry on unceasingly by night and by day. Weeks after weeks, and months too, were consumed in these toilsome exertions; the progress, however, though slow, was so persevering that they had penetrated at length to no less than 100 feet in depth from the entrance. But by that time becoming thoroughly exhausted, and beginning again to despair of the hard and hitherto fruitless labor, some of them ventured to remember certain improving tales of an old king, who had found, on making the calculation, that all the wealth of Egypt in his time would not enable him to destroy one of the Pyramids. These murmuring disciples of the Arabian prophet were in the midst of their various counsel, they heard a great stone evidently fall in some hollow space within no more than a few feet on one side of them! In the fall of that particular stone, there almost seems to have been an accident that was more than an accident. Energetically, however, they instantly pushed on in the direction of the strange noise; hammers, and fire, and vinegar being employed again and again, until, breaking through a wall surface, they burst into the hollow way, "exceeding dark, dreadful to look at, and difficult to pass," they said at first, where the sound had occurred. It was the same hollow way, or properly the pyramid's inclined and descending (present) entrance passage; but now it not only stood before another race, and another religion, but with something that the others never saw, *viz.*, its chief leading secret, for the first time since the foundation of the building, nakedly exposed; and exhibiting the beginning of an internal arrangement in the Great Pyramid, which is not only unknown in any and every other Pyramid in Egypt, but which the architect here, carefully finished, scrupulously perfected, and then most remarkably sealed up before he left the building to fulfil its prophetic destination at the end of its appointed thousands of years. A large angular fitting stone that had made for ages, with its lower flat side, a smooth and polished portion of the ceiling of the inclined and narrow entrance passage, quite indistinguishable from any other part of the whole of its line, had now dropped onto the floor before their eyes; and revealed that there was just behind it, or at and in that point of the ceiling which it had covered, the end of another passage, clearly ascending therefrom and towards the south, out of this also southward going but descending one! (See Plate IX.)

But that ascending passage itself was still closed a little further up by an adamantine portcullis, or rather stopper, formed by a series of huge granite plugs of square wedge-like shape dropped, or slipped down, and then jammed in immovably, from above. (Note the above fact, which we shall hereafter comment upon.) To break them in pieces within the confined entrance passage space, and pull out the fragments there, was entirely out of the question; so the grim crew of Saracen Mussulmans broke away sideways or round about to the west through the smaller ordinary masonry, and so up again (by a huge chasm still to be seen, and indeed still used by all would-be entrants into the further interior) to the newly discovered ascending passage, at a point past the terrific hardness of its lower granite obstruction. They did up there, or at an elevation above, and a position beyond the portcullis, find the passage way still blocked, but the filling material at that part was only limestone; so, making themselves a very great hole in the masonry along the western side, they there wielded their tools with energy on the long fair blocks which presented themselves to their view. But as fast as they broke up and pulled out the pieces of one of the blocks in this strange ascending passage, other blocks above it, also of a bore just to fill its full dimensions, slid down from above, and still what should be the passage for human locomotion was solid stone filling. No help, however, for the workmen—the Commander of the Faithful is present and insists that, whatever the number of stone plugs still to come down from the mysterious reservior, his men shall hammer and hammer them, one after the other, and bit by bit to little pieces at the only opening where they can get at them, until they do at last come to the end of all. So the people tire, but the work goes on; and at last, yes! at last! the ascending passage, beginning just above the granite portcullis, and leading thence upward and to the south is announced to be free from obstruction and ready for essay. Then, by Allah, they shouted, the treasures of the Great Pyramid, sealed up from the fabulous times of the mighty Ibn Salhouk, and undesecrated, as it was long supposed, by mortal eye during all the intervening thousands of years, lay full in their grasp before them.

On they rushed, that bearded crew, thirsting for the promised wealth. Up no less than 110 feet of the steep incline, crouched hands and knees and chin together, through a passage of royally polished white limestone, but only 47 inches in height and 41 in breadth they had painfully to crawl, with their torches burning low. Then suddenly they emerge into a long tall gallery, of seven times the passage height, but all black as night and in a death-like calm (see Plate XI.); still ascending though at the strange steep angle, and leading them away farther and still more far into the very inmost heart of darkness of this imprisoning mountain of stone. In front of them, at first entering into this part of the now termed "Grand Gallery," and on the level, see another low passage; on their right hand (see Plates IX. and X.) a black, ominous-looking well's mouth, more than 140 feet deep, and not reaching water but only lower darkness, even then; while onwards and above them, a continuation of the glorious gallery or upward rising hall of seven times, leading them on, as they expected, to the possession of all the treasures of the great ones of antediluvian times. Narrow, certainly, was the way—only 6 feet broad anywhere, and contracted to 3 feet at the floor—but 28 feet high, or almost above the power of their smoky lights to illuminate; and of polished, glistening, marble-like, cyclopean stone throughout. (See Plate XIV.)

That must surely, thought they, be the high-road to fortune and wealth. Up and up its long ascending floor line, therefore, ascending at an angle of 26°, these determined marauders, with their lurid fire-lights, had to push their dangerous and slippery way for 150 feet of distance more; then an obstructing 3 foot step to climb over (what *could* the architect have meant by making a *step* so tall as that?); next a low doorway to bow their heads most humbly beneath ("It is a rocky road up to the zenith of the hill of science and even the *king on his throne*, must *stoop* to conquer.") (See Plates XII. and XIV.); then a hanging portcullis to pass, almost to creep under, most submissively; then another low doorway, in awful blocks of frowning red granite both on either side, and above and below. But after that, they leaped without further let or hindrance at once into the grand chamber, which was and is still, the conclusion (so far as is known) of everything forming the Great Pyramid's interior; the chamber to which, and for which, and toward which, according to every subsequent writer (for no older ones knew any fragment of a thing about it), in whatever other theoretical point he may differ from his modern fellows—the whole Great Pyramid was originally built. (See Plate XV.)

And what find they there, those maddened followers in Caliph Al Mamoun's train? A right noble apartment, now called the King's Chamber, roughly 34 feet long, 17 broad, and 19 high, of polished red granite throughout—walls, floor, and ceiling; in blocks squared and true, put together with such exquisite skill that no autocrat emperor of recent times could desire anything more solidly noble and at the same time beautifully refined.

Ay, ay, no doubt a well-built room, and a handsome one, too; but what does it contain? where is the treasure? The treasure! Yes, indeed, where are the promised silver and gold, the jewels and the arms? The plundering fanatics look wildly around them, but can see nothing, not a single *dirhem* anywhere. They trim their torches and carry them again and again to every part of that red-walled, flinty hall, but without any better success. Nought but pure, polished, red granite, in mighty slabs, looks calmly down upon them from every side. The room is clean, garnished too, as it were; and, according to the ideas of its founders, complete and perfectly ready for its visitors, so long expected, and not arrived yet; for the gross minds of those who occupy it now find it all barren; and declare that there is nothing whatever of value there, in the whole extent of the apartment from one end to another; nothing, except *an empty stone chest without a lid.*

The Caliph Al Mamoun was thunderstruck, on receipt of this information. He had, through his workmen, arrived at the very ultimate part of the interior of the Great Pyramid he had so long desired to take possession of; and had now, on at last carrying it by storm, found absolutely nothing that he could make any use of, or saw the smallest value in. So being signally defeated though a commander of the Faithful, his people began plotting against him.

But Al Mamoun was a Caliph of the able day of Eastern rulers for managing mankind; so he had a large sum of money secretly brought from his treasury, and buried by night in a certain spot near the end of his own quarried entrance-hole. Next day he caused these same workmen to dig precisely there, and behold! although they were only digging in the Pyramid masonry just as they had been doing during so many previous days, yet on this day they found a treasure of gold; and the Caliph ordered it to be counted and lo! it amounted to *the exact sum* that had been incurred in the works, neither more nor less. And the Caliph (of course) was astonished, and said he could not understand how the kings of the Pyramid of old, actually before the Deluge, could have known exactly how much money he would have expended in his undertaking; and he was (apparently) lost in surprise. But as the workmen got paid for their labor, and cared not whose gold they were paid with so long as they did get their wages, they ceased their complaints, and dispersed; while as for the Caliph, he returned to the city, El Fostat, notably subdued, musing on the wonderful events that had happened; and both the Grand Gallery, and the King's Chamber, with its "stone chest without a lid" were troubled by him no more.

The way once opened, though no more traversed, by the Caliph Al Mamoun (as he presently left Egypt for his more imperial residence in Bagdad, Asiatic Turkey, and ended his days there in 842 A. D., about 40 years before the time of Alfred the Great. That way into the Great Pyramid then remained free to all; and "men did occasionally enter it," says one of the most honest chroniclers of that period, "for many years, and descended by the slippery passage which is in it, with no other alleged result than that some of them came out safe, and others died." (?)

The history of Egypt, from the reign of the Caliph Al Mamoun down to the invasion of that land by Napoleon Bonaparte, with his 70,000 red-republican soldiers in the year 1798, is one of bloodshed and murder; as very few, if any, of its rulers actually died a natural death. Under *such* circumstances, very little *reliable* history exists; either regarding that country, or the Great Pyramid that still stands on the banks of the Nile.

The city of El Fostat, in sight of the Great Pyramdi was taken and burned, and the women reduced to slavery, A. D., 905. From that time down to 970 A. D. when El Kahireh, or Cairo, was founded by Gohar—anarchy, bloodshed, rival and shortlived rulers, invasions, desolations, slaughters and battles form the record; and little or no better for a century following.

Professor John Greaves, the Oxford Astronomer, Visits the Great Pyramid.

(Sec. 64) Among the first of the scientists to visit the Great Pyramid in modern times, was Prof. Greaves, in the year 1637 A. D. His conclusions, after making many scientific measurements, were given to the public through his writings, and lectures, and started the scientific world to thinking. His example soon found imitators, that visited the pyramid, and they increased in numbers as the centuries passed by.

The natural instinct of nations soon singled out the Great Pyramid as being far more interesting than any other monument of the general Pyramid kind; while in that one building again, the same empty stone chest, which had so affronted the Caliph Al Mamoun, still offered itself there in the interior too, as the chief object for explanation. Why was it in such a place of honor? Why was the whole Pyramid arranged in subservience to it? Why was it, this mere coffer-box, so unpretending and plain? Why was it empty, lidless and utterly without inscription, continually demanded modern Europe? (It should be no enigma to an "Illustrious Mason.")

Gradually the notion grew that it might be a sarcophagus; and that it was a sarcophagus; and that it had been intended for "that Pharaoh who (in 1542 B. C.) drove the Israelites out of Egypt; and who, in the end, leaving his body in the Red Sea, never had the opportunity of being deposited in his own tomb."

But this idea was effectually quashed, for amongst other reasons, this forcible one—that the Great Pyramid was not only built, but had been sealed up too in all its more special portions, long before the birth even of that Pharaoh. Nay, before the birth of Isaac and Jacob as well; which disposes likewise of the attempt to call the Great Pyramid "the tomb of Joseph," whose mortal remains being carried away by the Israelites in their exodus, left the vacancy we now see in the coffer or stone box. Also the story of its being the coffer of King Cheops, or Chemmis, of the Royal and Fourth Dynasty, and *supposed* builder of the Great Pyramid according to the Greeks. Whereupon Professor Greaves pointed out "that Diodorus had left, over 1,600 years since, a memorable passage concerning Chemmis (Cheops) the builder (*supposed*) of the Great Pyramid, and Cephren (Shafre) the equally royal founder of the Pyramid adjoining. Although," said he, "those kings intended these for their sepulchres, yet it happened that *neither of them were buried there*. For the people being exasperated against them by reason of the toilsomeness of these works, and for their cruelty and oppression, threatened to tear in pieces their bodies, and with ignominy to throw them out of their sepulchres. Whereupon both of them, dying, commanded their friends to *bury them in an obscure place*."

Again, both Professor Greaves and other scholars salutarily brought up to check the then public mania for calling the coffer Cheops' coffin, the very clear account of Herodotus that King Cheops could not possibly have been buried in the Great Pyramid building above, simply because he was buried low down, in a totally different place; viz., "in a subterranean region, on an island there surrounded by the waters of the Nile." And as that both necessarily and hydraulically means a level into which the Nile water could naturally flow, it must have been at a depth of more than fifty feet beneath the very bottom of even the unfinished subterranean chamber, the deepest work found yet underneath, or connected in any way with, the Great Pyramid. Exactly such a locality, too, both sepulchral, and with precisely the required hydraulic conditions, has since then been found about 1,000 feet southeast of the Pyramid building. (See Plate XIX.)

The Sarcophagus Theory Successfully Exploded.

(Sec. 65.) All the single sarcophagus propositions for the benefit of that most remarkable stone chest in the red-granite chamber of the Great Pyramid having failed their remains have been merged into a sort of general sarcophagus theory, that some one must have been buried in it. And this notion finds much favor with the Egyptologists, as a school; though facts are numerously against them, even to their own knowledge. They allow, for instance, that in no other Pyramid is the *sarcophagus*—as they boldly call the empty stone chest, or granite box of other authors—contained high up in the body of the Pyramid, far above the surface of the ground outside; that in no other case, ("excepting the sarcophagus of the second Pyramid, but which is not known to have ever been occupied by a mummy"), it is perfectly devoid of adornment or inscription; that in no other case, not even the exception just alluded to in regard to the Second Pyramid, has the lid so strangely vanished; in no other case are the neighboring walls and passages so devoid of hieratic and every mythological emblem; in fact, they confess that the red granite coffer, with all that part of the Great Pyramid's chambers and ascending passages where it is found, is entirely unique was unknown before Caliph Al Mamoun's day (820 A. D.) and is strictly peculiar to the Great Pyramid.

Observe also with the alleged "sarcophagus," in the *King's* Chamber (for so is that apartment now most generally termed), that there was no ancient attempt to build the vessel up and about in solid masonry, in the most usual and truly effective manner for securing a dead body inviolate. On the contrary there were magnificently built white stone passages of a most lasting description, ready to lead a stranger right up to such far interior sarcophagus from the very entrance itself; while, more notably still, the shapely King's Chamber was intended to be *ventilated* in the most admirable manner by the "air channels" discovered by Col. Howard Vyse, in 1837 A. D.; evidently (as the actual fact almost enables us to say with security) in order that men might come there in the latter day, and look on and deal with, that granite chest, (key to the "Source of Measures") and look on, and deal with that open chest and live and not die.

Meanwhile, some few men with broad views and true in scientific researches—witness M. Jomard in the celebrated "Description de l'Egypte," and Sir Gardner Wilkinson in his own most deservedly popular works—had begun to express occasional doubts as to whether any dead body either of a king or of any other mortal man ever was deposited in the open vessel of the King's Chamber.

To quote all the "*pro's and con's*" of even the *scientific* and *noted* men of the past, requiring this "stone puzzle," would require over 100 volumes, as large as this to give the subject fair publicity. We cannot, however, overlook the celebrated

JOHN TAYLOR'S THEORY.

In the midst of such scenes, illustrating, unfortunately, what is actually going on, and chiefly applauded still, among the Egyptologists of the nineteenth century, came into public favor the celebrated John Taylor. (He was born in 1781 and died in 1864.) The result of his long and respectful researches, suggests more or less that, "The coffer in the King's Chamber of the Great Pyramid was intended to be a standard measure of capacity and weight; primarily in a special, exclusive, or selective manner, but ultimately for all nations; and *certain* nations, he considered, did thence originally receive their weights and measures; so that those of them who still preserve, to some degree, with their language and history, their *hereditary*, *aboriginal* weights and measures, may yet trace their prehistoric connection substantially with that one primeval, standard, metrological center for all the future world, the Great Pyramid.

"When the British farmer measures his wheat, in what term does he measure it? In *quarters*. Quarters of what? The existing British farmer does not know; for there is no capacity measure now on the Statute book above the quarter; but, from old custom, he calls his largest corn measure a quarter. Whereupon John Taylor adds in effect: "The quarter corn measures of the British farmer are fourth parts or *quarters* of the contents of the coffer in the King's Chamber of the Great Pyramid; and the true value in size of its particular corn measure, has not sensibly deteriorated during all the varied revolutions of mankind in the last 4,000 years."

John Taylor's Coffer Theory Practically Examined.

The above is a statement not to be implicitly accepted without a full examination; and something in that way can fortunately be instituted very easily; as thus:—The first part of the problem is merely to determine the cubical contents of the vessel known successively, from Caliph Al Mamoun's day to our own, as the "sarcophagus," "the empty box," "the lidless stone chest," or more philosophically and safely, so as not to entangle ourselves with any theory, "the coffer," in the King's Chamber of the Great Pyramid. From Colonel Howard Vyse's important work are drawn forth and arranged, in the following table, all the chief mensurations taken between 1550 A. D. and 1840 A. D., some of the principal authors being consulted in their original writings. Their measures, generally given in feet, or feet and inches, (the feet of all authors when not otherwise particularized, have been here assumed as English feet, and in some cases may require a correction on that account, but not to any extent sufficient to explain the chief anomalies observed) or Metres, are all here set down in British inches, to give a clearer view of the progress of knowledge in this particular matter. And now our only bounds to exactness will be, the capability of these educated men of Europe to apply accurate instrumentation to a regularly formed and exquisitely prepared specimen of ancient mechanical art.

MODERN MEASURES OF THE GREAT PYRAMID COFFER UP TO 1864

Authors of Measurements	Date	Coffer	Exterior			Interior		
		Material as Named	Length	Breadth	Height	Length	Breadth	Depth
	A. D.							
Bellonius......	1553	Black Marble...	144	72	......	......	......	......
P. Alpinus.....	1591	Black Marble...	144	60	60	......	......	......
Sandys........	1610	....	84	47	Breast High	......	......	......
De Villamont..	1618	Black Marble...	102	......	60	......	......	......
Prof. Greaves..	1638	Thebaic........	87.5	39.75	39.75	77.856	26.616	34.320
De Monconys..	1647	....	86.	37.	40.	......	......	......
M. Thevenot...	1655	Hard Porphyry	86.	40.	40.	75.?	29.?	......
M. Lebrun.....	1674	....	74.	37.	40.	......	......	......
M. Maillet.....	1692	Granite........	90.	48.	48.	......	......	......
De Careri......	1693	Marble........	86.	37.	39.	......	......	......
Lucas.........	1699	Like Porphyry.	84.	36.	42.	74.?	26.?	......
Egmont.......	1709	Thebaic Marble	84.	......	42.	72.?	......	......
Pere Sicard....	1715	Granite........	84.	42.	36.	......	......	......
Dr. Shaw	1721	Granite........	84.	36.	42.	72.?	24.	......
Dr. Perry.....	1743	Granite........	84.	30.	36.	......	......	......
M. Denon.....	1799	.....?.........	84.	48.	38.	......	......	......
M. Jomard and Eg. Fr. Ac...	1799	Granite........	90.592	39.450	44.765	77.836	26.694	37.285
Dr. Clarke.....	1801	Granite........	87.5	39.75	39.75	......	......	......
Mr. Hamilton..	1801	Granite........	90.	42.	42.	78.?	30.?	......
Dr. Whitman..	1801	....	78.	38.75	41.5	66.?	26.75?	32.
Dr. Wilson.....	1805	....	92.	38.	......	80.?	26.?	34.5
M. Caviglia....	1817	....	90.	39.	42.	78.?	27.?	......
Dr. Richardson	1817	Red Granite....	90.	39.	39.5	......	......	......
Sir G.Wilkinson	1831	Red Granite....	88.	36.	37.	......	......	......
Howard Vyse..	1837	....	90.5	39.0	41.0	78.0	26.5	34.5
Piazzi Smyth...	1864	Red Granite....	**90.1**	**38.72**	**41.27**	**77.93**	**26.73**	**34.34**
Dr. Grant......	1864	Red Granite....	......	38.75	......	......	......	......
Mr.Jas.Simpson	1864	....	89.92	38.68	41.23	77.85	26.70	34.31

N. B.—A note of interrogation after any of the *interior* measures indicates that they have been obtained by applying to the exterior measures the "thickness', as given by the observer; such thickness being supposed to apply to the sides, and not to the bottom, which may be different.

Review of the "Coffer Measure" as Given Above.

Look at them, is not the list a little appalling? An ordinary carpenter amongst us uses sixteenths of an inch quite frequently, and sometimes undertakes to make a special piece of cabinet work "fit to a thirty-secondth of an inch"; but our learned travelers commit errors of many whole inches; and this when they are voluntarily, and of their own prompting only, measuring the one and only internal object which they found to measure, or thought should be described by measure, in the whole interior of the Great Pyramid.

Professor Piazzi Smyth, after making several visits, and spending many months in measuring the Great Pyramid both inside and outside, with the most carefully prepared *special* implements of measure, says: "I feel compelled to say, that out of the twenty-seven quoted authors no less than twenty-two must be discharged summarily as quite incompetent, whatever their mental attainments otherwise, to talk before the world about either size or proportion in any important *practical* matter.

"Professor Greaves in 1638, the French Academicians in 1799, and Colonel Howard Vyse in 1837, are therefore the only three names that deserve to live as coffer measurers in the course of 250 years of legions of educated European visitors. Of these three parties thus provisionally accepted, the foremost position might have been expected for the Academicians of Paris. Professor Greaves lived before the day of European science proper. While Colonel Howard Vyse did not lay himself out for very refined measurements; but rather went through what he felt himself obliged to undertake in that direction, in the same fearless, thorough-going, artless but most honest manner in which the Duke of Wellington was accustomed to review a picture exhibition in London, beginning with No. 1 in the catalogue and going through with the whole of them conscientiously to the very last number on the list.

"The Colonel's measures, therefore, are respectable and solidly trustworthy with regard to large quantities, but not much more.

"With the French Academicians it is quite another thing; they were the men, and the successors of the men, who had been for generations measuring arcs of the meridian, and exhausting all the refinements of microscopic bisections and levers of contact in determining the precise standard scales. Their measures, therefore, ought to be true to the thousandth, and even the ten-thousandth part of an inch; and perhaps they are so in giving the *length* and *breadth* of the coffer; but, alas! in their statements of the *depth* inside, and the *height* outside, there seems to have been some incomprehensible mistake committed, amounting to nearly *three inches*. Under such circumstances and after having failed to obtain any satisfactory explanation from the Perpetual Secretary of the Academy in Paris, I have been compelled to discharge the French Academy, also, from the list of fully trustworthy competitors for usefulness and fame in Pyramid coffer metrology. Only two names therefore, are left—Howard Vyse, who has been already characterized and Greaves, in whom we have most fortunately a host indeed."

Sketch of the Eastern Traveling Oxford Astronomer, Prof. Greaves, in 1673

(Sec. 66.) He lived before the full birth of European science, but on the edge of an horizon which is eventful in scientific history; with an unusual knowledge, too, of Oriental languages, and a taste for travelling in the then turbulent regions of the East, Prof. Greaves belongs almost to the heroic time. Immediately behind him were, if not the dark ages, the scholastic periods of profitless verbal disquisitions; and in front, to be revealed after his death, were the germs of the mechanical and physical natural philosophy which have since then changed the face of the world.

Now every other visitor to the Great Pyramid, both, before and since Greaves, paid vastly more attention to the exterior than the interior of the coffer, he defined it particularly thus:—"It is in length on the west side 6.488 feet," "in breadth at the north end, 2.218 feet," "the depth is 2.860 feet."

Greaves' and Vyse's Coffer Capacity Determinations.

Cubical contents of the coffer in English inches by Greaves' full measures, in 1838:—

$$77.856 \times 26.616 \times 34.320 = 71.118.$$

And by Howard Vyse's measures, taken in 1837:—

$$78.0 \times 26.5 \times 34.5 = 71.311.$$

Several small corrections may possibly be applicable to these numbers as read off; we may accept for a *first approximation* the mean of the above statements, or 71,214 cubic inches, as the apparent capacity contents of the coffer of the King's Chamber.

Now, what proportion does that number bear, to the capacity of four modern English corn quarters, in terms of which British wheat is measured and sold at this date (1907)?

One English gallon is declared to be equal to 277.274 cubic inches; which quantity being multiplied for bushels, quarters, and four quarters, yields 70,982.144 English cubic inches. Whence the degree of agreement between a quarter modern British and a fourth part of the ancient coffer, or granite box, and possible type of a both primeval and *ancient* corn measure in the Great Pyramid, is at this present time as 17,746 : 17,804.

Red Granite the True Material of the Coffer.

By reference to the *third column* in our last table of "Modern Measurements of the Coffer," it will be observed that travellers have assigned the coffer to almost every mineral, from black marble to red granite, and porphyry of a color which no one has ventured to name. Yet John Taylor concluded for porphyry, and called the vessel the "Porphyry Coffer," even Piazzi Smyth in his early volume of "Life and Work," published before visiting the pyramid, named it porphyry.

He says: "Nevertheless, I having at last visited Egypt in 1864-5, after the publication of the first edition of my work, spent almost whole days and weeks in the King's Chamber of the Great Pyramid until all sense of novelty and needless mystery in small things had worn away; and decided without the smallest hesitation, for the material of the coffer being syenitic granite, exceedingly like but perhaps a little harder as well as darker than the constructive blocks of the walls of the King's Chamber containing it."

In every possible or even imaginable instance, such hard granite is wonderfully distinct, naturally from the soft limestone (sometimes, but with less error, called marble) of the rest of the Great Pyramid's structure; and it is not a little important, in all Pyramid research there to be able in that monument to detect for certain whenever the primeval architect abandoned the use of the limestone he had at hand, and adopted the granite procured with utmost toil and expense from a distance; whether it came from Syene, as modern Egyptologists usually determine, or from Sinai, as Professor Greaves infers; or from Atlantis, or America, as we think.

Professor Smyth again says:—"Sad confusion here between granite and porphyry in the seventeenth century; while in the 'unheroic eighteenth century' Anglo-Saxon ignorance of granite culminated. No fresh granite was then being worked anywhere direct from nature, and the monuments of antiquity composed of it were first suspected, and then alleged to be fictitious; as thus stated by a Mediterranean traveller in 1702:— 'The column of Pompey' at Alexandria. Some think it of a kind of *marble*, but others incline rather to believe that it was manufactured stone, or, as some writers put it 'of *melted stone*' cast in moulds upon the place. The latter reason is indulged in by many, for two reasons, (1.) for there is *not the least piece of that stone to be found* (naturally) *in any part of the world*, at this time; (2.) and the pillar is so prodigiously big and high that it could hardly be erected without a miracle." Prof. Smyth says: "I know it is alleged by those who believe the story of the Rhodian colossus that the ancients had the advantage of admirable machines to raise such bulky pieces; but I should reckon myself extremely obliged to those gentlemen if they would show me any probable reason why among so great a variety of Egyptian monuments of antiquity, there is not one of *marble*; and by what unaccountable accident the stone called *granite*, which was then so common, is now grown so scarce that the most curious inquiries into the works of nature cannot find the least fragment of it, that was not employed in ancient structures?

"And even though I should suppose with my adversaries, that the quarries out of which this stone was dug were by degrees so entirely exhausted that there is not the least footstep of 'em left, and that Nature herself has lost so much of ancient vigor and fecundity that she is not able to produce new ones, I may still be allowed to ask why granite was only used in obelisks or columns of a prodigious bigness; for if it were really a sort of (natural) stone or marble, I see no reason why we might not find small pieces of *it*, as well as of *porphyry* and other kinds of marble."

Replying to Professor Smyth's argument, and queries, as quoted above, we would say: (1.) the reason why we cannot find any similar piece of *marble*, or *granite*, to correspond with that of the coffer or walls in the King's Chamber, or the Column of Pompey (or Pompey's Pillar) that stands about 1,800 feet south of the walls of Alexandria *is*, that none of this stone was ever formed on, or brought from any landed continent *now in existence.* But, as one of the proofs of our theory, is, that it came from the "*Continent of Atlantis*," or the land that once formed the continent, now known as the Atlantic Ocean. (2.) And the reason why it seems *miraculous* to most students of Egyptology, in this enlightened day, that such massive stones as constitute the principal parts of the Great Pyramid, and such Monoliths as above mentioned, could be brought any great distance, or be raised, or placed in position when on the ground is: that they cannot conceive of any "lost art" or wisdom, not possessed by the mechanics and wise men of this enlightened day. (3.) While our present day mathematicians, have (practically) found a correct "quadrature of the circle," and the "Aztec Tempered Copper Manufacturing Company," of Seattle, Washington, has successfully tempered copper (97 per cent pure) to equal or excel the very best quality of steel, and the "Georgia Girl" has accomplished the feat of "*overcoming gravitation*"; we have much more to accomplish before the wise *architects* of this enlightened day and age, can duplicate the Great Pyramid.

(Sec. 67.) Wise Men Differ as to What is Limestone or Granite—Prof. Smyth says: — "When, for instance, my wife and I were living through several months in a tomb of the eastern cliff of the Great Pyramid Hill in 1865, a Cambridge man, with a most respectable name in science, and a sage-looking, experienced head of iron-grey hair, called upon us and remarked (to the lady, too, who knows a great deal more about minerals than I do) 'What a fine *granite* cavern you are living in!' Granite, indeed, poor man! when the petrified mummulites were staring at him all the time out of the nought but limestone on every side! And other travellers within the last few years have confidently talked of having seen granite in the entrance passage of the Great Pyramid, granite in the subterranean chamber, granite forming the casing stone heaps outside, granite, in fact, anywhere and everywhere; and basalt dykes in the Pyramid hill too, though in a country of pure mummulithic limestone.

"They, however, being free and independent writers, cannot be easily interfered with; but will my readers at least excuse me for insisting upon it, that for any would-be Pyramidist scholar it is a most awful mistake to say granite when he means limestone, or *vice versa*; and to see limestone where the primeval architect went to infinite pains to place granite. To talk thus interchangeably of the two is, indeed, over and above saying the thing that is not in minerology over and above taking hard for soft, and soft for hard; Neptunian for Plutonian; repletion with traces of organic existence for nought but crystals that never had a breath of life in them—it is also on the part of such individual a depriving himself of the only absolutely positive feature that can, or should, speak to in all Pyramid inquiry; as thus:—Questions of amount of angle, length of line, and measure of weight are all, even in the best modern science researches, questions of degree of approximation only; or of limits of approach to a something which may never be actually touched, or finally defined. But if white mummulithic limestone cannot be distinguished absolutely from red granite, or if one of those substances is said to glide so insensibly into the other, that no man can say with confidence where one begins and the other ends—the age for interpretering the long secret interior of the Great Pyramid has not yet arrived.

"But I will not consent to any such state of mind afflicting the readers of this present edition; and would rather, with them, as one amongst friends and often, in many other learned subjects, betters than myself, request their attention (before further discussing the coffer in the King's Chamber) to a prevailing feature of the *manner* in which the Great Pyramid makes its chief mechanical use of this triple rock, of strong colors and strange traditions, granite.

"There is granite in the Great Pyramid, and granite in various small Pyramids; yet so far from their being therefore alike, it is on that very account, or by that very means, that most difference may be detected both in their designs and even in the minds of their designers.

"Take the third Pyramid as an example; the Egyptological world hailed it as the 'Coloured Pyramid'; coloured, for sooth, because its casing-stones more than half-way up, were of red granite. That that little third Pyramid was therefore more expensive than the Great one, all its friends admit, and even boast of; but what else did it gain thereby? Lasting power, is the general idea; because granite is so proverbially hard. But, alas! granite, besides being hard, is also very brittle on account chiefly of its tri-crystallization, and is so largely expansible by heat, (NOTE—Having prepared in 1873, a number of slabs of different materials, both natural and artificial and then examined their lengths with a misroscopic beam-compass both in summer and winter, I found all the harder stones, agate, chalcedony, green-stone flint, porphyry, and marble too, afflicted with larger heat expansions than the soft, fine-grained lime-stones, such as either the white lime-stone of the Great Pyramid, or the black lime-stone of Ireland) that under the influence of a hot sun by day and cold sky by night, it loosens and crushes minutely the materials of its own surface to little pieces, film by film, and age after age— until now, after 3,000 years, those hard granitic casing-stones of the third Pyramid are rounded along their edges into pudding shapes, which can hardly indicate the angle they were originally bevelled to, within a handful of degrees. Yet the softer, and fair, white lime-stone which was chosen of old for the casing of the Great Pyramid (a variety of which lime-stone is found in the Mokattam hill on the east side of the Nile), and which was begun to be exposed to the weather before the third Pyramid or its builders were born, has joined to that softness, so much tenacity, smallness of heat expansion, and strong tendency to varnish itself with a brownish iron oxide exudation, that it has in some instances preserved the original angle of the casing-stones within a minute of a degree, and their original surface within the hundredth of an inch.

"But *because* the Great Pyramid architect found lime-stone to answer his purpose for casing-stones, did he therefore use it everywhere? No, certainly not. He knew it to be too soft to keep its size and figure in places where men do tend to congregate; and where strains and wear and tear may accumulate, and have to be strenuously resisted. In and towards the center, therefore, of the whole mass of the Great Pyramid, where strains do increase and the treasure was supposed to be kept, and where Caliph Al Mamoun in one age, and middle-class passengers from Australian steamers in another, rush trampling in to see what they can get by force,—there, whatever other purpose we may presently discover he also had, the Great Pyramid architect begin to use granite in place of lime-stone. And in the deep and solemn interior of that building, where he did so employ it, there was no sun to shine and heat up by day, no open sky to radiate cold at night; but only closed-in darkness and a uniform temperature from year to year, and century to century.

"There was, therefore, no tendency in granite to separate its component crystals *there*; but very great necessity for its hardness to resist the continual treading, or hammering and mischief-working by the countless visitors of these latter days. For the granite portion of the Great Pyramid (excepting only the portcullis, or stopper, blocks at the lower end of the first ascending passage) begins in the so-called ante-chamber apartment. A narrow chamber through which all visitors must pass, in order to reach that further, grander, and final Kings' Chamber wherein the employment of granite culminates; and wherein is to be seen standing loose and quite movable, except for its immense weight, on the open, level, granite floor, that Pyramid coffer or long and high granite box, which is still awaiting our further and higher examination."

Professor Smyth again asks—"*Why of that Size?* If we grant, temporarily, for mere present argument's sake, that the long *rectangular granite* box, or coffer, in the King's Chamber of the Great Pyramid was intended by the precise, measured, amount of its cubic contents to typify, as Mr. Taylor has suggested, a grand and universal standard of capacity measure—can any reason in either nature or science be shown, why it should have been made of that particular size and no other? In a later age the designer of such a *metrological* vessel would have been hampered by custom, confined by law, or led by precedent. But in the primeval day of the foundation of the Great Pyramid, who was there then to control its architect; or from whom could that truly original genius have copied anything; or lastly, what was there to prevent *his* making the coffer therein of any size he pleased?"

I will tell you why: If the coffer had been carved out for no other purpose than for a "capacity measure," the architect and designer would, most probably, have been "hampered by custom, confined by law, or led by precedent." But, as this vessel was constructed for a double purpose, there was but one size and shape to make it. One of its purposes was most certainly intended for an "International measure of capacity," or at least a copy of the then existing law; the other, and principal purpose was, to "*illustrate* to candidates seeking knowledge of the hidden mysteries of life, both here, and beyond the veil." Any "illustrious mason" *could* reveal the details.

In the primeval day of the building of the Great Pyramid, over one thousand millions of people inhabited the earth; and, as that civilization had then a genealogy reaching back for at least 50,000 years, there were hundreds of similar designs extant to copy from; and the architect and builders of the Great Pyramid, *would not have ranked*, in their day, higher than hundreds of their fellows. Can there be any doubt in the mind of the reader, at this stage of our argument, that the Great Pyramid, including its mysterious *coffer*, was *not built* in 2170 B. C.? When semi-barbarism and mechanical ignorance, groped their way through Lower Egypt's darkness? Or, if built by a Deified architect and Deified workmen, (as suggested by Professor Smyth,) then *why*, if built for a moral or religious landmark, has it not had Deific protection from the marauders? *It has been protected*, but just in that proportion that the ancient founders outwitted the strength and willingness of the primeval and modern marauder.

The Coffer Measures in Detail in English Inches.

By Prof. P. Smyth, in 1865, with corrections down to 1880: "This vessel, the sole contents of the dark King's Chamber, and termed according to various writers, stone box, granite chest, lidless vessel, porphyry vase, black marble sarcophagus, and coffer—is composed, as to its material, of a darkish variety of red, and possibly syenitic, granite. And there is no difficulty in seeing this; for although the ancient polished sides have long since acquired a deep chocolate hue, there are such numerous chips effected on all the edges in recent years, that the component crystals, quartz, mica, and felspar, may be seen (by the light of a good candle) even brilliantly.

"The vessel is chipped around, or along, every line and edge of bottom, sides, and top; and at its southeast corner, the extra accumulation of chippings extends to a breaking away of nearly half its height from the top downwards. It is, moreover, tilted up at its south end by a black jasper pebble about 1.5 inches high (such pebbles are found abundantly on the desert hills outside and west of the Great Pyramid) recently pushed in underneath the southwest corner. The vessel is therefore in a state of strain, aggravated by the depth to which the verticle sides have been broken down as above; and great care must be taken in outside measures, not to be misled by the space between some parts of the bottom and the floor, itself also of polished red granite.

"As for the under surface of the bottom of the coffer (speculated on by some persons as containing a long inscription) I felt it near the south end with my hand, and tried to look under it also when a piece of magnesium wire was burning there, without being sensible of any approach to hieroglyphics or engraving. But as to the inner or upper surface, of the bottom, and also the verticle sides of the vessel, both inside and ou'—all the ancient surfaces there are plainly enough polished smooth, and are without any carving, inscription, design, or any intentional line or lines; they are also all of them simple, plain, and flat (sensibly to common observation); excepting only the top margin, which is cut into in a manner implying that a sarcophagus lid once fitted on, sliding into its place from the west, and fixable by three steady pins, entering from the lid into holes on the western side. The west side of the coffer is therefore lowered all over its top surface, except at the north and south ends, by the amount of depth of such ledge cut-out, or 1.72 inch; and the other, or east, north, and south sides are, or should be lowered to the same depth on *their inner edges*, and to a distance from inside to out of 1.63 inch. But the fullness of this arrangement cannot be seen now, because in some places both ledge and top of sides are broken away together; and in others, though much of the inner base-line of the ledge remains—thanks to its protected position—the upper and true surface of the coffer's side has all been chipped away. In fact, it is only over a short length near the northeast corner of the coffer that the chippers have left any portion of its original top edge. And a cast of that corner taken in 1879, by Mr. Wayman Dixon shows (as compared with my photograph and also with the frontispiece to Vol. I. of "Life and Work"), that a further portion of the side's top surface, indeed an awfully large conchoidal-shaped block, *has disappeared since* 1865.

"The whole question, therefore, of the full depth of the coffer rests on one very small portion of the northeast wall, so to speak, of the coffer—a portion, too, which becomes smaller and smaller every year that we live.

"Only at that northeast corner, too, is there an opportunity of measuring the verticle depth between the ancient top surface of a side and the bottom surface of the *ledge*; and it was, by repeated measure, found by me = from 1.68 to 1.70 and 1.75; say mean = 1.72 inch.

"The sides of the ledge depression appeared to me to have been vertical, or without any dovetailing; and the horizontal base breadth of such cut-out measuring from within, to, or towards the "without" of the coffer—and restoring the sides to their original completeness before the chipping away of the edges is—

On and near Western portion of Northern side . . . 1.65
On and near Middle portion of Northern side 1.62
On and near Eastern portion of Northern side 1.73
On and near Northern part of Eastern side 1.55
On and near Southern part of Eastern side. . *All Broken*
On and near Eastern and Western parts of Southern side . . . . *All Broken*

MEAN. . . . . . = *1.63* in.

"But this appearance of the coffer's ledge having been *rectangular* has been, since my visit, successfully shown by Dr. Grant and Mr. W. Dixon to be a mistake. For although everywhere else all the overhangings of an acute ledge have been broken away to beyond the vertical, yet there is a small part left near the northeast corner, which speaks unmistakably to an acute-angled shape; not by any means so sharply acute as that of the sarcophagus of the Second Pyramid, but decidedly and intentionally on the acute side of rectangular.

"Along the western side are three fixing-pin holes, 12 inches deep, and 0.84 in diameter save where they are broken larger, as is chiefly the case with the middle and southern one. The three holes have their centers at the following distances from the north end: *viz.*, 16.0, 45.3 and 75.1 respectively.

"It is inconceivable how the French Academicians could have pictured the coffer, as they did, without representing anything of this ledge cut-out, or of the fixing-pin holes; unless they looked upon these traces as a comparatively modern attempt to convert the original pure coffer into a sarcophagus, and which they were therefore bound to overlook in their description of the *original* vessel. But we are to note both states."

OUTSIDE OF COFFER: MINUTER DETAILS OF ITS FIGURE.

"The planes forming the four external vertical sides of the coffer, which have never yet been questioned by any other measurer, appeared to me to be not very true; excepting the east one, whose errors are under 0.02 or perhaps 0.01 inch; while the north, west and south sides are so decidedly concave as to have central depressions of 0.3 and 0.5 inches; or more particularly

	Inches
"At North side, central or hollow depression of coffer's side (measured from a *horizontal* straight-edge touching the side at either end, and in a horizontal plane), or the quantity of central *depression*, near bottom, say *d*	0.45
Central *depression*, near middle of height	0.20
Central *depression*, near top	*0.12*
Mean	*0.26*
At West side, central *depression*, near bottom	0.35
At West side, central *depression*, near middle	0.15
At West side, central *depression*, near top	*0.10*
Mean	*0.20*
At South side, central *depression*, near bottom	0.28
At South side, central *depression*, near middle	0.18
At South side, central *depression*, near top	0.10
Mean	*0.19*

"Again, when the straight-edge is applied *vertically* to the sides, east side comes out true, but the others concave.

On North side, the maxima of such vertical depression
or d . . . . $=0.20$ and 0.28
On West side, d', at South end . . . . $=0.00$
On West side, d', at North end . . . . $=0.20$
And on South side, d', at different distances from
East to West . . . . $=0.08$, 0.12, and 0.04

External Measures of the Coffer.

"The corners and edges of the coffer are so much chipped, that the steel claws I had had prepared for the sliding rods, to adapt them from inside to outside measures, were found not long enough to span these modern fractures and reach the original polished surfaces. A method was therefore adopted of making up the sides of the coffer with straight edges projecting beyond it at either end; and then measuring between such straight edges and on either side or end of the coffer.

Length of Coffer Outside Result of Three Tests.

On East side, near bottom	90.50
On East side, 10 inches under top	90.15
On East side, above top	90.20
On West side, near bottom	89.20
On West side, near top	89.95
On West side, above top	90.05
Mean length	*90.01*

The above mean, however, represents only the mean length of the edges of the two sides, not of the whole coffer, on account of the concavity of the two external ends; wherefore, if we desire to state the mean length for the mean of each end surface, we must subtract two-thirds of the mean central concavity, as previously determined; *i. e.*$=0.17$ for the north end, and similarly 0.13 for the south end; so that, then, the mean *length* for mean of each end of coffer$=89.71$ British inches, or$=89.62$ Pyramid inches.

Breadth of Coffer, Outside.

At North end, near bottom 39.05

At North end, near top	38.70
At North end, over top	38.67
At South end, near bottom	38.80
At South end, near top	38.60
At South end, over top	38.50
Mean	38.72
Correction for curvature of West side	.07
Mean breadth of mean sides	38.65
Concluded breadth = British inches	38.65
or = Pyramid inches	38.61

Height of Coffer, Outside.

"Height of coffer outside, eliminating the stone under bottom, and the sarcophagus ledge of 1.72; *i. e.*, measuring from coffer bottom to *extreme* ancient top of sides, is—

At North end, eastern part of it	=41.30
At North end, northeastern part of it	=41.22

At other parts, no original top left.

Mean height = 41.27 British, or 41.23 Pyramid inches.

"Corrections in *capacity* computations for a supposed hollow curvature of under side of bottom; agreeably with three, out of four upright sides; and also agreeably with the construction of the under sides of casing stones, which rest on their circumferences; on account of a slight hollowing away of their central areas; say = 0.10 inch. Concluded capacity computation height = 41.17 British, or 41.13 Pyramid inches.

Sides, Thickness of.

"For this purpose two vertical straight edges higher than the sides were placed opposite each other, in contact with the inside and outside surfaces of any flank of the coffer; finding at successive parts of the coffer circumference bearing from center:

	Inches
South-southwest thickness	= 6.00
South thickness	= 6.00

South-southeast thickness	= 5.95
East-southeast thickness	= 5.85
East thickness	= 5.95
East-northeast thickness	= 6.10
North-northeast thickness	= 5.95
North thickness	= 5.98
North-northwest thickness	= 6.10
West-northwest thickness	= 5.95
West thickness	= 6.10
West-southwest thickness	= 5.95
Mean thickness of vertical sides, British inches	= 5.99

"The above measures were repeated (on March 28, 1865), and proved sensibly true for this method of measurement over the top edge of coffer; but if calipered lower down, it is probable that a silghtly increased thickness would have been found there.

Bottom of Coffer, Thickness of.

"By difference of heights of two straight edges of equal length, applied, one inside and one outside—the outside one being further propped up, where required, by a third straight edge inserted under the bottom—there was found:

Under Southwest corner, thickness of bottom	= 7.00
Under East side, thickness of bottom	= 6.60
Under East-northeast, thickness of bottom	= 6.87
Under East-northeast again, thickness of bottom	= 6.90
Under North end, thickness	= 6.90
Under North-northwest, thickness of bottom	= 6.85
Under North-northeast, thickness of bottom	= 6.80
Under West-northwest, thickness of bottom	= 7.20
Under West, thickness of bottom	= 6.90
Under South-southwest, thickness of bottom	= 7.15
Mean thickness of bottom around the edges (the thickness of bottom in the center cannot at present be satisfactorily or easily measured). British inches	= 6.92

INTERNAL MEASURES OF THE COFFER.

"The surfaces of the coffer seem very true and flat over the greater part of their extent, but betray, on examination by straight edges, a slight convergence at the bottom toward the center.

INSIDE LENGTH OF COFFER BY SLIDER 70.

(Correction +0.13 added to all the readings for length of this Slider.)

Distance between East and West Sides of the North and South ends.	Level at Which Observations Were Taken			
	4 to 6 inches under top	Middle of Height	6 to 7 in. above bottom	0.6 in. above bottom
Close to Eastern side	Broken at S. E. Cor.	78.08	77.93	77.68
At ⅓d breadth from East	78.06	78.06	77.97	77.56
Half way between East and West.	78.06	78.08	78.06	77.53
At ⅔ds breadth from East	78.05	78.09	78.06	77.59
Close to West side	78.03	78.06	78.01	77.57
Mean at each level	78.05	78.07	78.01	77.59

Mean of the whole, or the inside length of coffer = { 77.93 British inches. / 77.85 Pyramid inches. }

INSIDE BREADTH OF COFFER.

(By Slider 25, not requiring any correction.)

Distance between North and South ends, along the East and West sides.	Level at Which Observations Were Taken				
	Near Top	Near Middle	6 to 7 in. above bottom	0.6 in. above bottom 1st time	0.6 in. above bottom 2nd time
Close to North end........	26.68	26.69	26.65	26.40	26.39
At ⅓d length from N. end	26.60	26.69	27.00	26.72	26.54
Near middle of length	26.64	26.80	27.10	27.05	27.05
At ⅔ds length from N. end	26.67	26.78	26.77	26.67	26.75
Close to South end........	26.78	26.78	26.63	26.49	26.49
Mean at each level........	26.67	26.75	26.83	26.67	26.64+

Mean of the whole, or the inside breadth of coffer = { 26.73 British inches. / 26.70 Pyramid inches. }

Inside Depth of Coffer.

"The measure of this element is taken from the inside bottom of the coffer—which is apparently smooth and flat—up in the shortest line to the level of the original top surface of the north, the east, and the south sides; and of the west side also, *presumably*, before it was cut down to the level of the ledge which runs around the inner edges of the north, east, and south sides, and all across the west side's top.

"Now, the depth of that ledge was before ascertained $=1.72$ inch below the original top; a block of wood was therefore prepared of that thickness, and placed on the west side, and also on the base surface of the ledge wherever found on the other sides, to support one end of a straight edge, whose other end rested on some parts of the original top of the coffer's sides, which are still visible at and about the northeast corner.

Inside Depth From Original Top of North, East, and South Sides

(By Slider 25, not requiring any correction.)

Part of Length where observations were taken.	Part of Breadth Where Observations Were Taken			
	Near East Side	Near Middle	Near West Side	Mean at each part of Length
0.6 inches South of inner N. end	34.30	34.28	34.26	34.28
3.0 inches South of inner N. end	34.44	34.36	34.35	34.38
5.0 inches South of inner N. end	34.42	34.41	34.28	34.37
10.0 inches South of inner N. end	34.40	34.38	34.28	34.35
24.0 inches South of inner N. end	34.36	34.38	34.26	34.33
Mean at each part of breadth	34.38	34.36	34.29	33.44

General mean, or the inside *depth* of coffer $= \begin{cases} 34.34 \text{ British inches.} \\ 34.31 \text{ Pyramid inches.} \end{cases}$

Inside Diagonal Measures of Coffer.

"Diagonals inside the north end; from either low corner at bottom up to a measured height of 30.0 inches, *i. e.*,

the greatest height quite free from fractures; then—
From low northeast to 30. high northwest=39.71 Br. in.
and from low northwest to 30. high northeast=39.70 Br. inches.

"Diagonals inside west side; from either corner below, up to a height of 30 inches measured at the sides—
Or from low southwest to 30. high northwest=83.19 Br. in.
and from low northwest to 30. high southwest=83.13 Br. in.

Cubic Diagonals of Coffer.

	British Inches
From low southwest to 30. inches high northeast	=87.13
From low southeast to 30. inches high northwest	=87.05
From low northeast to 30. inches high southwest	=87.06
From low northwest to 30. inches high southeast (temporarily supplied)	=87.11

"These cubical diagonals give sensibly less than the diagonals computed from the lengths and breadths; on account, apparently, of the extreme points of the corners of the bottom not being perfectly worked out to the exact intersections of the general planes of the entire sides. But they seem abundantly sufficient to prove general rectangularity of figure, in all the main part of the coffer's interior."

The Sarcophagus Theory of the Coffer.

"With all this accumulation of little bits of information, then, let us now try what is the size of the coffer as a whole. And on so doing, we must, of course, let the opposition sarcophagus theory of Egyptologists be heard over again; especially when it has something to say touching shape, as well as size.

"The inside dimensions of the coffer being (roughly) 6.5 feet long, 2.2 feet wide, and almost 3 feet deep, are at least long enough and broad enough for a coffin (for the averaged sized man); except, that a very corpulent individual or a man much over 6 feet tall, would have to be planed down to fit the receptacle. And if it is rather deeper than convenient or necessary, no objections are interposed, as there is now proved to be a ledge cut into the top of the thick sides of the vessel, and quite suitably for a lid.

"As there *is* a ledge, an intention at some time to put on a lid may be inferred; but it is still to be proved whether a lid ever *was* put on by the architect of the Great Pyramid, and especially for sarcophagus purposes; because, first, with a sarcophagus lid of the ordinary style and thickness fastened into that ledge, the coffer could not have passed through the closely fitting doorway of the room; it would have been several inches too high; in fact, the coffer itself without a lid is too large by over half an inch to get it in or out of this chamber; showing *conclusively*, that this receptacle was placed there before the completion of the Pyramid itself above the 50th layer of stone. Second, a sarcophagus lid fastened into that ledge would have betokened the accomplishment of the last rites to the dead; and they would have included among all Eastern nations, but more especially the contemporary, indigenous Egyptians, the engraving of the deceased's name, titles, deeds, and history on the coffer, both inside and out. But there is nothing of that kind there; so the Great Pyramid coffer remains still the smooth sided, vacant, lidless chest of Caliph Al Mamoun's Arab tale; quite capable of having been made at any time into a sarcophagus; but testifying in the most positive manner that it never was completely so converted, whatever may have been the reason why or wherefore.

"Taking the coffer measures, for instance, as of the whole vessel before the ledge was cut out, from the previous pages, in Pyramid inches, then—

LENGTH, BREADTH, DEPTH, VOLUME.

Coffer interior = 77.85x26.70x34.31 = 71,317 Pyramid ins.
Coffer exterior = 89.62x38.61x411.31 = 42,316 Pyramid ins.
That is, within the limits of accuracy of the modern measures the volume of the exterior is *double* that of the *interior;*

and the simplest even relation between them is that of *capacity.*

"Again, the mean thickness of the sides of the coffer being assumed from the measures, in Pyramid inches 5.952, and of the bottom 6.866 we have (from a formula first prepared by Mr. Henry Perigal)—

Coffer's bottom = 89.62x38.61x6.866 =	23,758
Coffer's sides = 2(89.62x26.70)x34.31x5.952 =	47,508
	71,266

or again, we find a *duplicity* of the one quantity against the other; and the only apparent simple relation between the two, and of the sum of both with the interior of the vessel, is that of *capacity.*

"If then, now we may justifiably say, that though the coffer is possibly what John Taylor did not think it, viz.—a blind sarcophagus and a symbolical coffin, it is also most positively what he did consider it, viz.—a vessel at whose birth certain leading geometrical requirements both of, and for, capacity measure presided and governed:—then, in that case, what is its precise capacity?

What Did the Capacity of the Coffer Prove to be?

"For the coffer's length and breadth elements we can quote plenty of measures, but the equally necessary depth is a weak point; because, as already explained, every particle of the original top of the sides is cut or broken away, except some little patches near the northeast corner. Those were in place when measured by Professor Smyth in 1867, but who will guarantee that they are there still, when men *will* hammer that exquisite gift inherited from the remote past, merely in the ignorant notion of sending their friends at home a chip of "Cheops' coffin."

"No lid has ever been seen by any historical individual; but every man of the present age may test the truth of the following mechanical adaptation: viz.—the ledge, though acute angled, is cut out with precisely such a base breadth and depth that a frame made to fit it flush with the ancient top of the sides would, when let down in vertical plane, and diagonally inside the coffer, just form the diagonal of said coffer's interior; and the frame's height at that moment would exactly measure the coffer's depth. Hence the breadth of the ledge, continued across the coffer from west to east, would continue to give us an outstanding test of the coffer's original depth, long after all thoughtless visitors, *whither soever scattered*, shall have thoughtlessly knocked away every particle of the original top of the sides.

"In coffer measuring, however, just as it usually is in all matters of science, (in our day) no two human measurers ever agree exactly even on the same parts; and all that finite man can hope for is, to come within moderate limits. So then, must it be with the coffer's cubic contents.

"Taking the ledge breadth as 34.282 Pyramid inches, then the coffer's cubic contents in cubic Pyramid inches, are:—

(1.)	By interior length and breadth and by depth from ledge breadth....................	=71,258
(2.)	By interior of coffer, by all direct measures.	=71,317
(3.)	By half the exterior volume directly measured	=71,160
(4.)	By sum of bottom and sides directly measured	=71,266
	Mean of the whole.............	71,250.

"The above statement shows that we here have a vessel, on the whole excessively near to 71,250 cubic Pyramid inches, but it was pretty evidently *intended*—by enabling us so nearly to bring out that number in several different ways. While that precise quantity, and the care for that quantity, of just so many cubic inches, rather than any other, expressed in Great Pyramid measure, are so impossible for the Egyptologists to explain on any sarcophagus theory of their own, that they do not attempt it; we must now see what the Great Pyramid itself may have to add to this, in setting forth some scientific reason why this vessel before us, the coffer in the King's Chamber, is not only 'a symbolical sarcophagus, but one adapted likewise to something further and higher connected with *capacity* measure.' "

DENSITY AND TEMPERATURE.

(Sec. 68.) *Of both Earth and Great Pyramid from the Latest Measures.*—"There are no inscriptions, yet is there much instruction on the interior walls of the Great Pyramid; and as the coffer, when taken merely by itself, has proved, thus far, too hard a riddle for our full interpretation, let us try something of the teaching of the walls which precede, as well as those which surround it.

GRANITE SYMBOLISMS OF THE ANTE-CHAMBER.

In order to enter the Great Pyramid's so-called King's Chamber, we have to pass, from the Grand Gallery, through the "Ante-Chamber." (See Plates XIII. and XIV.) It is very appropriately so called, because it is a little room which *must* be passed through *before* the King's Chamber can be entered or the coffer seen; and in passing through it the attentive eye may note many more complicated forms there than in any other (known) part of the Great Pyramid. Amongst these *notanda* are certain vertical lines above the southern or further doorway.

Travelers have contradicted each other so much about the number of these lines, that nothing less than a perfect picture of them, will set the matter at rest. (See Plate XIII.) They extend the whole way evenly from ceiling to door-top, nearly, ending in a short curved bevel. They are each 107.4 inches long, 2.8 inches deep, and 3.8 inches broad; with six inch spaces between, and with similar six inch spaces also between the outer side of each outermost line, and the bounding of the ante-room's south wall containing them. It is not so much a system of *four* lines as an example of surface divided into *five* equal portions or spaces.

As the doorway is only 42 inches high, and the dividing lines of the wall above it are apparantly drawn down to the doorway's (now broken) top, a man of ordinary height standing in the ante-room and looking southward (the direction he desires to go, in order to reach the King's Chamber), cannot fail (if he has a candle with him, for otherwise everything is in darkness here) to *see* this space divided into five. And when he bows his head very low, as he must do to pass under the said southern doorway of only 42 inches high, he bends his head submissively under that symbol of division into five; and *should* remember that five is the first and most characteristic of the Pyramid numbers. (See Plate XIV.)

Wall Courses of the King's Chamber as Described by Different Travelers.

(Sec. 69.) Owing to the prominence of the individuals quoted, *this is amusing.* Not without reason, therefore, was it, as the intelligent traveller may readily believe, that the Architect of the Great Pyramid desired to impress that division into five upon every visitor's mind, just the last thing before such visitor should bow down, previously to passing through the low, solid doorway, cut out of granite 100 inches thick. But after that, rising up in the midst of the ultimate King's Chamber beyond—what should any and every beholder witness there?

According to that usually most correct of travelers, Professor Greaves, *he* says of the King's Chamber that every one may see there "from the top of it descending to the bottom, there are but *six* ranges of stone, all which, being respectively sized to an equal height, very gracefully in one and the same altitude run round the room."

Well, though that is a very pretty arrangement, and the grace of it is perfectly true, it is not the accomplishment of a division into five; so let us try an older traveler, Sandys, of a curt and epigrammatic style, and writing in 1610. Says he, of the self same King's Chamber: "A right royal apartment, and so large that eight floors it, eight roofs it; eight stones flagge the ends and sixteen the sides." Worse and worse.

Says Dr. Pocock in 1743: "Six tiers of stones of equal breadth compose the sides;" which account M. Fourmont, on the part of France, confirms in 1755 by laying down that "the walls are composed of six equal ranges." The still more famous traveler, Dr. Clarke, makes Cambridge in 1801 support Oxford in 1639, by particularizing that "there are only six ranges of stone from the floor to the roof"; while, finally, that usually infallible author on Egypt, Mr. Lane, with his clever relatives, the Pooles, *almost* natives of Cairo, seem to set a seal forever on the mistake by declaring: "Number of courses in the walls of the King's Chamber, six."

What *could* have blinded all these duly warned men, and sent them following each other down one and the same too easy rut of simple, ridiculous error? Dr. Richardson, in 1817, was more original, if error there apparently must be in these dark room investigations by candle light in the interior of the Great Pyramid; for he chose a new and hitherto untrodden line of erring for himself, sententiously writing of the room, "Lined with broad, flat stones, smooth and highly polished; *each* stone ascending from the floor to the ceiling." But having once begun this new mis-description, he soon has followers; we find Lord Lindsay, of 1838, announcing: "A noble apartment, cased with enormous slabs of granite 20 feet high" (or a little more than the whole height of the room); and Sir William R. Wilde with his companion signing himself M. R. I. A., in 1837, equally publish to the world, as observed by themselves: "An oblong apartment, the sides of which are formed of granite reaching from the floor to the ceiling."

And yet will it be credited that the walls of this chamber are divided into five horizontal courses, neither more nor less, almost four feet (47.09 inches) high each; and that these courses are most easy to count, as they must have been undoubtedly most expensive for the architect to have constructed, because every course is, as Professor Greaves indicated, of the same height as every other, except the lowest, which course is less by nearly 1-10 part, (about 5 Pyramid inches) if measured from the floor; but is the *same* height if measured from the base of its own granite component blocks, which descend in the wall to beneath the floor's level. (See Plate XV.)

The Pyramid Number of the King's Chamber's Wall Courses and the Stones in Them.

(Sec. 70.) The first traveller noted, as having discovered that there were but *five* courses of stone contained in the walls of the King's Chamber, was Lord Egmont in 1709, and the second Dr. Shaw in 1721, perhaps, however, some others earlier or later; but Professor Smyth was the *very* first to contend against the world for the correctness of this number of courses, and connecting the teaching of the architect in the ante-chamber, and the quinary character of the Pyramid's first arithmetic.

Yet, quinary though it be for some purposes, it is decimal for others, as shown here in almost juxtaposition; first, by the tenth part nearly, taken off the height of the lower course, by the manner of introduction of the floor; and then by the 10x10 number of stones, exactly, of which the walls of this beautiful chamber are composed; no two of which are exactly the same size or dimensions, with the possible exception, of the top layer on both the east and west ends of the chamber. It will be *noted* (see Plate XV.) that there is one break in the continuity of the wall courses, on the north side, ending in the N. E. corner; at that point,one stone extends through the 2nd and 3d layers, (or 94.18 inches high, or wide) and extends from the *northeast* corner west, about 135.5 pyramid inches. Or, in other words, here is placed one granite block, that shows a face of 7 feet 10 and 18 one-hundredths inches high or wide, by 11 feet 3½ inches long. We shall contend in the closing article of this work, that through the space occupied by this immense granite block, there is a *door*, or outlet to other chambers, and hinted at in a previous section, as *possibly* being located on the 75th and 100dth layers of stone.

The ancient occupiers of this *most remarkable building*, must have had, not only some extraordinary method of lighting these several chambers, but had also a method by secret touch, or *mysterious force*, to cause these walls to open at their pleasure.

A Marked Portion of the King's Chamber and the Coffer are Mutually Commensurable in Pyramid Numbers.

But the tenth part, nearly, taken off the visible height of the lower granite course of the chamber's walls; what was that for? Its first effect was to make that course, within the fraction of an inch, the same height as the coffer; and the second was, more exactly, to make the capacity, or cubic contents of that lowest course of the room, so decreased, equal to fifty times the cubic contents of the coffer, already shown to be 71,250 cubic Pyramid inches. Two separate sets of measured numbers in Pyramid inches for the length, breadth and height, of that lowest chamber course giving as follows, when divided by the coffer's contents—

$$\frac{412.14 \times 206.09 \times 41.9}{71,250} = \frac{3,558,899.}{71,250}$$

And

$$\frac{412 \times 206 \times 42}{71,250} = \frac{3,564,624.}{71,250}$$

Hence, close as was the connection of the several parts of the coffer with each other by the tie of capacity, equally close is the connection of the coffer with the adjusted course of the granite room in which it stands, and by *capacity* measure also. While, if the multiple before was 2, and is 50 now—is not 50 twice 25, or double the number of its own inches in the cubit of the Great Pyramid, the significant 5 x 5?

Commensurabilities Between the King's Chamber and the Structural Masonry Courses of the Whole Pyramid.

The significent fives and tens that play such a prominent part in the King's Chamber, do not end there. Violently different are the courses of masonry in their successive heights of the Great Pyramid; but whatever height or thickness of stones any one course is begun with, it is kept on at that thickness precisely right through the whole Pyramid at that level (*i. e.*, if we may judge of the unknown interior of the stratum by the four external edges thereof); though the area of the horizontal section may amount to from ten feet square to a dozen acres.

To secure this equality of thickness for a course—in fact, just as with the equal height of the granite courses in the King's Chamber walls, but on a larger scale—it is plain that immense arrangements must have been instituted beforehand, with the masons of many quarries; and such arrangements imply method, mind, and above all, *intention*. The level of the 50th course of construction of the whole Pyramid is the level also of that granite floor in the King's Chamber, whereon is resting the coffer, a vessel with commensurable capacity proportions between its walls and floor, in a room with 5 courses, composed of 100 stones, and with a capacity proportion (the coffer) of 50 to the lowest of those courses; which lowest course has been made 5 inches less in height than any of the others of its fellows.

Any person could hardly but see, then, that the so-called, in the dark ages, King's Chamber, should rather have been termed the chamber of the standard of 50. Can we also say, with reference to our present inquiry—of 50 Pyramid inches employed in capacity measure.

Fifty Pyramid inches form the ten-millionth of the earth's *axis* of rotation; or decidedly the proper fraction to begin with for capacity measure, when we have already chosen one-ten-millionth of the *semi-axis* for linear measure. The reason being, that in measuring linear distances, say amongst the spheres of the universe, men measure them from center to center, and therefore have only to take account of the radii of each; but in dealing with either their capacity or weight, we must take each sphere in its entirety, or from side to side, that is, by its diameter rather than radius.

Symbolic Hints From the Ante-Chamber.

(Sec. 71.) A hint how to deal with this second part of the question, may be gathered from some of the hitherto incomprehensible things in the little ante-chamber to this far grander chámber. Little indeed, is the ante-chamber, when it measures only 5 feet, 5.2 inches in breadth from east to west, 8 feet and 8.3 inches long from north to south, and 12 feet 5.4 inches high; but it has a sort of granite wainscot on either side of it, full of detail. (See Plate XIII.)

On the east side, this wainscot is only 8 feet, 9.1 inches high, and is flat and level on the top; but on the west side it is 9 feet, 3.8 inches high, and has three semi-cylindrical cross hollows of nine inches radius, cut down into it, and also back through its whole thickness of 8.5 to 11.7 inches to the wall. Each of those semi-cylindrical hollows stands over a broad, shallow, vertical, flat groove 21.6 inches wide, 3.2 inches deep, running from top to bottom of the wainscot, leaving a plaster-like separation between them. The greater part of the pilasters has long since been hammered away, but their fractured places are easily traced; and with this allowance to researchers in the present day, the groove and pilaster part of the arrangement is precisely repeated on the east side, within *its* lower compass of height.

These three grand, flat, vertical grooves, then, on either side of the narrow ante-chamber, have been pronounced long since by Egyptologists to be part of a vertical, sliding portcullis system for the defence of the door of the King's Chamber. There are no blocks now to slide up and down in these grooves, nor have such things ever been seen there, by our race of people; but the gentlemen point triumphantly to a fourth groove, of a different order, existing to the north of all the others, near the north beginning of the ante-chamber; and with *its* portcullis block, they say, still suspended, and ready for work.

The Granite Leaf of the Ante-Chamber.

The portcullis block, however, referred to above, contains many peculiarities which modern Egyptologists have never explained; it was first carefully described by Professor Greaves under the appellation of "the granite leaf," (from the so-called 'leaf' or 'slat,' or sliding door over the water-way of a lock-gate in an English navigation canal). Unlike the others, its groove is only 17.1 inches broad (against 21.6 inches for the others), and in place of being like them cut down to, and even several inches into, the floor, and terminates 3 feet, 7.7 inches above that basal plane; so that the leaf's blocks—for it is in two pieces, one above the other—stand on solid stone of the walls on either side, and could not be immediately lowered to act as a portcullis, though an Emperor should desire it. When this portcullis was in real use, there were other parts connected with it, that are now hidden away in some one of the secret vaults, in the *apparent* solid Pyramid. This is evident, for if chiseled down in their vertical plane, there would still be 21 inches free space between the leaf and the north entering wall and doorway where a man might worm himself in, in front of that face of it; and 4 feet, 9 inches above the leaf's utmost top, where men might clamber over; and where many adventurers have sat, candle in hand, in absolute solitude, thinking over what it might mean.

The granite leaf is, therefore, even by the meagre data given, a something which a simple portcullis will not explain. And so do likewise the three broader empty pairs of grooves to the south of it, remarkable with their semi-cylindrical hollows on the west side of the chamber. Various ideas as to their uses have been given out from time to time, but no single idea advanced, has ever received much of a following. But the *real Masonic student*, however, can read volumes in every chamber and passageway of this *most* remarkable structure.

Earth's Density Number in the Great Pyramid.

The Pyramid's earth's mean density comes out, if at all, most simply, and to an accuracy at once of three places of figures, certain, from—the cubic contents of the coffer in Pyramid inches, divided by the 10th part of 50 inches cubed. Whence, trusting to the most analytical measures yet taken, it is: 71,250 divided by 12,500; the quotient being 5.70; a number which modern science may confirm, at some future day, and does meanwhile include near the very center of its best results thus far. While the grand 5.7 of the seven stones forming the 5th and topmost course of the walls of the King's Chamber, crown the conclusion.

Of Temperature Corrections and How Affected.

(Sec. 72.) Thus, at the great observatory of Pulkova, near St. Petersburg, where they value an insight into small fractions of a second perhaps more than anywhere else in the world, the very able Russian astronomers have placed their chief clock in the "subterraneans," or cellars, of the observatory. Something of the same sort is now practiced at the Royal Observatory, at Greenwich; while the Paris Observatory has beat the record by placing its clock 95 feet under the surface of the ground, in the very peculiar 'caves' which exist there.

Over forty years ago, at the Royal Observatory, at Edinburgh, Scotland, observations were taken with very long-stemmed thermometers, whose bulbs were let down into rock at various depths; and it was found that, notwithstanding the possibly disturbing effect of rain-water soaking down through fissures, there is such an astonishing power in a mass of stony matter to decrease temperature variations, that at the *surface* of the ground—

The mean semi-annual variation of heat amounts to 50° F.
At three inches under the surface............... 30° F.
At three feet under the surface................. 16° F.
At six feet under the surface................... 10° F.
At twelve feet under the surface................ 5° F.

At twenty-four feet under the surface.......... 1° F.

At 95 feet, then, from the surface, as in the case of the Paris Observatory, how very slight and innocuous to the most refined observation of season temperature. But how much more slightly affected still, and how admirably suited to a scientific observing room, must not the King's Chamber in the Great Pyramid be, seeing that it is shielded from the outside summer heat and winter cold, by a thickness of nowhere less than 180 feet of solid masonry.

Temperature of the King's Chamber.

In the Great Pyramid, as before observed, there is a grand tendency for numbers, things, and principles going by "fives"; and this seems carried out even in its temperature, for it may be described, first of all, as a temperature of one-fifth; that is, one-fifth the distance between the freezing and boiling points of water, above the former.

The first grounds for this belief were certain approximate observations by M. Jomard, in the "Description de l'Egypt"; and which indicate something like 68° Fahr. as nearly the original temperature of the King's Chamber of the Great Pyramid, if under both ventilation and other intended normal circumstances of its foundation. And 68° Fahr. is precisely a temperature by, and according to, nature of one-fifth. And I learn that the mean annual temperature of the city of Cairo is identical, or 68° Fahr.; the authority is, from a five years record of the Austrian Meteorological Society, A. Buchan, Esq., reporting.

Thirty-seven years after M. Jomard had measured in the King's Chamber the extra temperature of 71.6° Fahr. (*i. e.* 3.6° *extra* according to this subsequent theory), Colonel Howard Vyse cleared out the two ventilating channels; and reported, without having heard any idea that the temperature had been theoretically too high—that instantly upon the channels being opened, the ventilation re-established itself, and with a feeling to those in the chamber of most agreeable *coolness*. But no sooner had he left, than the Arabs most perversely stopped up the ventilating channels again; and now, the temperature ranges anywhere from 70° to 76° Fahr. according to the number and class of visitors, just preceding the recording of the same.

The Vibration of the King's Chamber Is Said To Be the Tone of Nature, the Letter "F."

(Sec. 73.) If so, this was important in the presentation of certain degrees of the ancient Cult. It is stated by certain musical experts that have visited this chamber, that when not more than half a dozen persons are present, by striking on the coffer with a drum-stick, 446 vibrations, or the musical sound of the letter "F." is heard .

Temperature and Pressure Data for the Coffer's Weight and Capacity Measure.

The coffer at the present moment, in no more of its right, or original temperature, than its right and original size, when so much of it has been broken bodily away by the hammering of the representative men of modern society and their attendant trains. But the barometric pressure in the chamber happily defies such power of disturbance, and keeps, by the law of the atmosphere over all region, expressively close to 30.000 Pyramid inches.

At the above mentioned atmospheric pressure, 68° temperature, and the coffer's cubic contents of 71,250 Pyramid inches of capacity, filled with pure water (though only as a temporary practice expedient)—do form the grand, earth-commensurable, *weight* standard of the ancient Great Pyramid.

Of all parts of the Great Pyramid amenable to accurate linear measure, there are none presenting such advantages therefore as the King's Chamber, far in its interior; because the said Chamber is—1. Equable in temperature; 2. Unvisited by wind, sand, or other such natural disturbances of the outside of the building; 3. Of simple rectangular figure; 4. Erected in polished, dense, hard, red granite, and, 5. It exhibits the longest lines of any part of the Pyramid, both in that hard material, and in a horizontal position; with vertical end-pieces too, in rectangular emplacement, or exactly as most suitable to the modern refinements of "end-measure" (See Plates XIV. and XV).

KING'S CHAMBER MEASUREMENTS IN DETAIL. BY PROF. P. SMYTH.

(Sec. 74.) Probably the most correct statement ever published of the measurements in detail, of the King's Chamber, in the Great Pyramid, are those that follow, from the pen of that painstaking Egyptologist, Professor Smyth, on his last visit there, *viz:*

	Inches.
LENGTH of South side, near floor level	
Mean of four measurements	= 412.6
North side, Mean of three measurements	= 412.47
Mean of both North and South sides, (British Inches)	= 412.54
(Pyramid Inches)	= 412.13
Assumed true length on the whole, (Pyramid In.)	= 412.132
(Or, 34 feet, 4 + inches.)	
BREADTH of King's Chamber near East end	
Mean of two measures	= 206.3
Near West end, (British Inches)	= 206.3
Mean East and West ends, (British Inches) ...	= 206.3
(Pyramid Inches)	= 206.09
Assumed true Breadth on the whole (Pyramid Inches)	= 206.066
(Or, 17 feet, 2 + inches.)	
HEIGHT of King's Chamber near Northeast angle of room; Mean of seven measurements in British Inches	= 230.70
(In Pyramid Inches)	= 230.47
Assumed true height on the whole, (Pyr. In.)	= 230.389
(Or, 19 feet, 2⅓ + inches.)	
DIAGONALS OF FLOOR:—	
From Southwest to Northeast corner	= 462.0
From Northwest to southeast corner	= 461.3

Mean measured floor diagonals, (British inches) = 461.65
(Pyramid Inches) = 461.19

(Or, 38 feet, $5\frac{1}{5}$ inches.)

DIAGONALS OF EAST WALL:—

Low Northeast to high Southeast corner ...... = 309.2

Low Southeast to high Northeast corner, substracting 1.6 inches for hole in low Southeast corner.............................. = 310.0

Mean length of diagonals, (British Inches) ... = 309.6

Mean length of diagonals, (Pyramid Inches).... = 309.3

DIAGONAL OF WEST WALL:—

Low Southwest to high Northwest corner ...... = 310.4

Substract one inch for a sunken floor stone = 1.0

(The other diagonal not measureable on account of a large and deep hole in floor in northwest corner of chamber, whereby men entering have gone on excavating at some time to underneath that part of the floor whereon the coffer stands; but are not known to have found anything but solid limestone masonry and mortar.)

Mean of the west wall, (in British Inches).... = 309.4
(In Pyramid Inches).... = 309.1"

Again considering Pyramid inches in the King's Chamber to signify Pyramid cubits outside the building, the following results come out correct to six places of figures:— Take the length of the King's Chamber 412.132 to express the diameter of a circle. Compute by the best methods of modern science, the area of that circle; throw that area into a square shape, and find the length of a side of such a square. The answer will be 365.242 Pyramid cubits; a quantity which not only represents the mean of all the measures of the length of the Great Pyramid's base side, but defines the number of mean solar days in a mean solar tropical year.

SYMBOLISMS OF THE ANTE-CHAMBER.

(Sec. 75.) To reach the King's Chamber of the Great Pyramid we have to pass through the Ante-Chamber; we have already gathered some useful hints from there, yet far from all that it was capable of giving.

One of the principal features mentioned regarding this Chamber, in a previous section was, the three curved hollows in the higher, or western, granite wainscot. There are no such hollows on the eastern side, and it is, moreover, cut off at the top to an absolutely lower level than what the western hollows descend to. Nearly every investigator asks, why was this east wainscot so cut down; evidently it was done *purposely*, from the perfection of the work by the original builders.

The architect is dead, but you may still virtually question him, in such a building of number, weight, and measure, by ascertaining *how much?* What height, for instance, was the eastern wainscot cut down to?

The answer is: 103.0 inches; since assumed, within the limits of the measures,—103.033 Pyramid inches. That is just half the King's Chamber breadth, and is therefore important. It has been found that the floor of the Ante-Chamber, is partly in granite and partly in limestone; and that the length of the former portion is given (in the mean) as 103.033 Pyramid inches; and here are placed two similar and of the place characteristic lengths of granite in rectangular position to each other. This is said to represent *square* measure; but what is the circular equal, *in area*, of such a square? The mean length of the whole ante-chamber is given at 116.26 Pyramid inches; this is made up of 103.03 of granite, and 13.23 of limestone; Major U. A. Tracey, pointed out, that 116.260 is the diameter of a circle having precisely equal area to a square of 103.033 in the side. Whereupon the Abbe and Chanovine Moigno exclaimed in his scientific journal, *Les Mondes*, "Who could pretend now that the diversity of the materials forming the floor, and their relations and differences of length, were a brute accident on the part of the ancient architect of 4,000 years ago?" And still less when the following additional features are produced by these numbers, 103.03 and 116.26, in their

Pyramid positions, and Pyramid *inch* units of measure there:

(1.) 103.033x5 (Pyramid number)=515.165; or is the length in Pyramid inches of the cubic diagonal of the King's Chamber.

(2.) 103.033x50 (the number of masonry courses of the Pyramid the chamber stands upon)=5151.65; or is in Pyramid inches the length of the side of square of equal area to a triangle of the shape and size of the Great Pyramid's vertical meridian section.

(3.) 116.260x2=232.520; or is, in Pyramid inches, the mean, nearly, of the 1st and 2nd heights of the King's Chamber.

(4.) 116.260 x *pi*=365.242..&c.; or shows the number of mean solar days in a mean solar tropical year.

(5) 116.260 x *pi* x 5 x 5=9131.05; or is, in Pyramid inches, the length of a side of the base of the Great Pyramid from a mean of all the measures.

(6.) 116.260 x 50=5813.0; or is, in Pyramid inches, the ancient vertical height of the Great Pyramid, from a mean of all the measures.

Hence, as the earlier of the above cases, including the 103.-033, show, the uses of the east wianscot of the ante-chamber, in being lower than the west wainscot, have been most remarkable. But, as every student of the Great Pyramid is led to ask—"can any object be assigned to the west wainscot being of the greater height it has been found to be by measure, *viz*:—111.8 Pyramid inches?"

It being so signal a feature of the chamber, and executed expensively and solidly, shows conclusively, that it was purposely intended by the builders of the Great Pyramid through their architect. And for the purpose to have an additional design to assist in solving, the hidden mysteries of *perfect* mathematics.

Mr. W. C. Pierrepont, of Pierre Pont Manor, Jefferson County, N. Y., some 38 years ago, pointed out, that "if a model of a meridian section of the Great Pyramid be conceived to stand on the flooring of the ante-chamber, vertically over the center of the granite leaf, then, the north foot of such pyramidal section rests on the great step at the head of the grand gallery, exactly there where the ramp line continued comes through; and south of such pyramidal section rests on the granite floor of the passage leading from the ante-chamber onwards to the King's Chamber; and is defined there to within a tenth of an inch by a 'joint' line in the granite; the only joint line too in that passage.

From that joint line in the floor, then, the vertical angle to the ceiling of the ante-chamber immediately over the singular and most important, granite leaf's center = $51° 51'$, or the Great Pyramid's angle side rise; and from the same joint line to the center of the lower stone of the granite leaf (which divides the whole height, into base side and vertical height $\div 100$) the angle of $26° 18'$ nearly, or the angle of all the inclined passages of the Pyramid."

The Granite Leaf Inch Measurement.

A strange structure is the granite leaf in the ante-chamber, standing all across the room between the floor and ceiling, as it does, is hedged about with important symbols connected with the scientific theory of the Great Pyramid; some objectors to the Pyramid scientific theory have said, "We do not admit the reality of Pyramid inches with its original builders, when such inches are obtainable by subdividing immense lengths; but show us a single such inch, and we may believe." Whereupon Major U. A. Tracey, R. A., pointed out that such single inch is actually marked, and in a Pyramid manner, on, or rather by means of, the above granite leaf in the ante-chamber; and is thus explained:—

"In that small apartment its grand symbol on the south wall is the already mentioned illustration of a division into five: and if the symbol had virtue enough to extend into and dominate some features in the next or King's Chamber (as in illustrating its now undoubted number of *five* wall courses), why should it not typify something in its own chamber as well? But what is there in the ante-chamber, divided into five? "The Great Pyramid's own scientific, earth-commensurable, cubit"; for here it is so divided in the shape of this projecting *boss* on the granite leaf, just five inches broad. And, further, that fifth part of that cubit of the Great Pyramid's symbolical design is divided before our eyes into five again; for the thickness of this remarkable bôss is on fifth of its breadth. So there you have the division of the peculiar Pyramid cubit into 5x5 inches."

Further measures of the BOSS on the granite leaf, by Dr. J. A. S. Grant, in Dec., 1874: "We measured the BOSS and found it just out from its stone *one inch;* and also to be removed from the center of the breadth of its stone exactly *one inch;* measurements which corroberate former measurements."

PRINCIPAL AND LEADING MEASURES CONNECTED WITH THE INTERIOR OF THE GREAT PYRAMID.

(*For their application see Plates I. to XV.*)

(PRESENT) ENTRANCE INTO GREAT PYRAMID.

(Sec. 76.) This is at present, simply a hole, or door way, at upper end of a hollow passageway, inclining thence downwards and inwards. It is situated on the northern flank of the Pyramid, in a very broken part of the masonry now, at a height above the ground, or pavement, rudely and imperfectly considered about: (in Pyramid feet and inches)—49 feet.

	Feet	Ins.
Distance of the center of that doorway hole eastward of center of the Pyramid's northern flank, as between its E. and W. ends..	24	6.
Height of said doorway, transversely to length of the passage way, of which it is the outer, northern, end	3	11¼
Breadth of the same........................	3	5.56
Angle of descent of the floor of the passage southwards........................	26°	28′

		Feet	Ins.
Length along that downward, and southward, slope, from a supposed original northern beginning of this passage, to its junction lower down with the first *ascending* passage inside the building, in Pyramid feet and inches	=	82	4.
Thence to Caliph Al Mamoun's broken hole	=	17	10.
Thence, cheifly by excavation through solid rock, but still in one straight, downwardly inclined line as before, to the well's lower mouth	=	215	2.
Thence, to the end of the inclined and full bored part of the passage	=	24	8.
Thence, in horizontal direction to the north wall of Subterranean Chamber	=	27	.....
Whole length of descending entrance passage	=	367	.....
Part length, or from "the 2170 mark" in the upper part of the passage to its falling into Subterranean Chamber	=	337	9.
Bore in horizontal subterranean region:—			
For height	=	3	
For breadth	=	2	9.

SUBTERRANEAN UNFINISHED CHAMBER.

Flat finished ceiling, length East to West	=	46	.....
breadth North to South	=	27	1.

Depth of walls from said ceiling, variously and irregularly, from 3 feet, 4 inches, to 13 feet, 4 inches; floor not yet cut out of the rock, and walls not full depth.

Small blind, horizontal hole or passage commencement, penetrating into the rock Southwards, from south wall of this chamber low down; length	=	52	9.
height	=	2	7.
breadth	=	2	5.

THE ASCENDING PASSAGE; (Limestone.)

Starts in an upward and Southward direction, from a point on the descending entrance passage, 82 feet, 4 inches inside the ancient building; and the first 15 feet of its length is still filled up with the fast jammed granite plugs.

(NOTE—If this passageway was cleaned out it would reveal a part of the *real* entrance.)

		Feet	Ins.
The whole length, from the descending passage up to junction with, and entrance into the Grand Gallery is	=	128	6.4
Measured angle of floor's ascent southwards	=	26°	8′
Transverse height of the passage bore, now 3 feet, 11 inches, to 4 feet, 11 inches; anciently	=	3	11.24
Breadths now, in broken state from 3 feet, 6 inches to 5 feet; anciently	=	3	5.56

GRAND GALLERY; (Limestone.)
ALSO, AND FURTHER ASCENDING.

Length of inclined floor line, from N. to S. wall	=	156	10
Measured angle of ascent, southwards	=	26°	17′
Vertical height, at any one *average* point	=	28	3½
Overlappings of roof, in *number*	=	36	
Overlappings of the walls, in *number*	=	7	
Ramps height	=	1	9
breadth	=	1	8
Breadth of floor between ramps	=	3	6
Breadth of gallery above ramps	=	6	10
Breadth of gallery between first overlap	=	6	4.2
Breadth of gallery between 2nd. overlap	=	5	10.4
Breadth of gallery between 3rd. overlap	=	5	4.6
Breadth of gallery between 4th. overlap	=	4	10.8
Breadth of gallery between 5th. overlap	=	4	5
Breadth of gallery between 6th. overlap	=	3	11.2
Breadth of gallery between 7th. overlap	=	3	5.4
Great step at southern end of gallery, vertical height of north edge	=	3	....
Length along the flat top from north to south	=	5	1
Lower and further exit, or South doorway passage, height	=	3	7.7
breadth	=	3	5.4
length horizontally from G. G. to ante-chamber	=	4	4½

		Feet	Ins.
Upper exit, at top of eastern wall at its southern end, height	=	2	9
breadth	=	1	8

ANTE-CHAMBER; (Limestone and Granite.)

Extreme length, North to South	=	9	8.26
Extreme breadth at top, East to West	=	5	5·2
Extreme height at top, East to West	=	12	5·3
Eastern wainscot, granite, high	=	8	7·03
Western wainscot, granite, high	=	9	3·8

Granite (density=0.479, earth's density=1) begins to be employed in the course of the length of this room, and in the *Granite Leaf* which crosses it, at various distances, as 8 to 24 inches, from North wall, in floor, and side walls.

Exit passage, horizontal, from ante-chamber, southward to King's Chamber, in granite all the way; length	=	8	4.2
height at the North end	=	3	7·7
height at the South end	=	3	6
breadth at the South end	=	3	5·4
Number of vertical grooves on South wall	=	4	
Length of each groove	=	8	11.4

KING'S CHAMBER. (Granite.)

Structure entirely in granite, form rectangular, length, East to West	=	34	4·132
breadth, North to South	=	17	2.066
height, floor to ceiling	=	19	2.389
from base of walls, below the floor, to ceiling	=	19	7·35

The walls are in 5 equal height courses, and composed of 100 blocks, no two of which are exactly the same size; except the top course on the East and West ends; and they extend the entire width of the Chamber.

The hollow coffer therein; mean length outside	=	7	6 01
The hollow coffer therein; mean length inside.	=	6	5.85

		Feet	Ins.
The hollow coffer therein; mean height outside	=	3	5.23
The hollow coffer therein; mean depth inside	=	2	10.31
The hollow coffer therein; mean breadth outside	=	3	2.61
The hollow coffer therein; mean breadth inside	=	2	2.7
North air channel, length to exterior of Pyr.	=	233	
South air channel, length to exterior of Pyr.	=	174	3
Supposed height of their exits there.........	=	331	

The lower part of these air channels just before entering the King's Chamber, are bent at a large angle in the vertical and the Northern one is further tortuous in azimuth; so that they cannot be used as a means of looking through to the daylight sky, from the King's Chamber—though they may ventilate it admirably when cleared of modern obstructions.

The 'hollows' or needlessly called 'Chambers' of *Construction* above the King's Chamber, are of the same length and breadth of floor, but not above 30 to 50 inches high, except the uppermost of the five, which angular, or gable, roofed (See Plate XIV.).

Horizontal Passage to Queen's Chamber.

		Feet	Ins.
Length from North end of Grand Gallery, Southward, to the beginning of low part of the passage under Grand Gallery floor........	=	18	1.8
Thence to low portion of floor..............	=	90	5.5
Thence to North wall of Queen's Chamber....	=	18	.....
Average height of longest part.............	=	3	10.34
Of Southern deep part = 5ft, 7½ ins.; breadth	=	3	5.15

Queen's Chamber. (Limestone.)

Length from east to west (in Pyr. ft. and ins.)	=	18	10.7
Breadth—north to south (in Pyr. ft. and ins.)	=	17	1.8
Height at north and south walls (in Pyr.ft.& in.)	=	15	2.4
Height in center of gable ridge of ceiling.....	=	20	4.4
Grand niche in the East wall; Height of....	=	15	3
Breadth, greatest below..................	=	5	1.3
Breadth, at 1st. overlap..................	=	4	4.25
Breadth, at 2nd. overlap..................	=	3	5.5

		Feet	Ins.
Breadth, at 3rd. overlap	=	2	6
Breadth, at 4th. overlap	=	1	7·5
Eccentricity of Niche, or displacement of its vertical axis southward from central vertical line of the east wall	=	2	1

Air channels exist in North and South walls; but blinded anciently inside, by a solidly left, uncut-out thickness of 5 inches of stone and their outcrop on the Pyramid flank now, not known.

Wall courses, number of, equally heighted all round up to the level of the top of North and South walls	=	6	.....

Additional wall courses in the upper gables of East and West walls, not yet examined.

Wall courses, as reported by Mr. W. Dixon approximately—

1st. or lowest, in height	=	3	.....
2nd. from floor, in height	=	2	10
3rd. from floor, in height	=	2	8
4th. from floor, in height	=	2	6
5th. from floor, in height	=	2	2
6th. from floor, in height	=	2	.....

THE WELL. (Lime-stone.)

Enters near North-west corner of Grand Gallery shaft square in bore; measures in length of side of bore	=	2	4
Distance of center of entrance from the North end of Grand Gallery	=	2	10
Vertical depth to grotto in rock, under masonry of Pyramid	=	58	6
Further vertical depth, with some horizontal distance, to junction with the lower part of the entrance passage near the Subterranean Chamber	=	133	.....

NAME OF DEITY IN VARIOUS TONGUES.

These names of God include names of the Supreme Being, or, among polytheists, those of the principal deity or the chief of the gods; also the generic names, with the different nationalities, for god or a god. The alleged names of God range themselves in three classes: (1) Those which are, beyond doubt, properly so designated; (2) those which are, beyond doubt, improperly so called,—are erroneously said to be names of the Deity; and (3) those of a doubtful character,—are said to be Deific names, but for which the evidence is not conclusive. Those in the second class have been excluded from this list. Those in the third class have been included herein, and have an asterisk (*) preceding them. All others pertain to the first class.

Wm. Emmette Coleman.

DEITY.	TONGUE.
Adi-Buddha	Hindu
Adon.	Hebrew
Adonai	Hebrew
Ahura Mazda	Eranian
Akua	Hawaiian
Al	Hebrew
Aleim	Hebrew
Allah	Arabic
Almighty	English
Amen	Egyptian
Ammon	Egyptian
Amun	Egyptian
Amun-Ra	Egyptian
Ana	Chaldean
Anu	Chaldean
Anyambia	Gaboon
*Artugon	Tartar
As	Teutonic
Assur	Assyrian
Asura	Vedic
Atua	Tahitian
Aum	Hindu
Avalokiteshwara	Hindu
Baal	Phœnician
Batara Guru	Javanese
Batava	Borneo
Bel	Babylonian
Bel-Marduk	Babylonian
*Belu	Welsh
Bhagavata	Hindu
Bhagwan	Gond
Bilu-Bili	Babylonian
Bobowissi	Afr. Gold Coast
Bogh	Russian
Bogu	Slavonic
*Boze	Polish
Brahma	Hindu
Brihaspati	Vedic
Buddha	Hindu
*Cali	Irish
Ceil.	Welsh
Chemosh	Moabite
*Chodia	Irish
Christ	English
Christos	Greco-Hebrew
Conshobar	Irish
Creator	English
*Crom	Irish
Dea (female)	Roman
Deity	English
Deon	Welsh
Deos	Greek
Deus	Roman
Deva	Hindu
Deva	Lithuanian
Dewas	Lettish
Dia	Gælic and Irish
*Dia	Essequibo
Dieu	French
Dio	Italian
Dios	Spanish, Portuguese
Diu	Welsh
Dovydd	Welsh
Dumnedeu	Roumanian
Duw	Welsh
Dyaus	Vedic
Dyaush-Pitar	Vedic
Ehyeh	Hebrew
El	Hebrew
Eloah	Hebrew
Elohim	Hebrew
El-Shaddai	Hebrew
Elyon	Hebrew
Engai	Masai
Esus	Gaulish
Gad	Hebrew
God	English
Godh	Icelandic
Got	Old German
Gott	German
Govinda	Hindu
Gud	Scandinavian
Gudh	Icelandic
Guth	Gothic
Hara	Hindu
Hari	Hindu
Hara-Hari	Hindu
Heavenly Father	English
Heitjubib	Hottentot
Herre (Lord)	Swedish
Hiranyagharba	Vedic
Hotoke	Japanese
*Hu	Celtic
Iddio	Italian
Iesous	Greco-Hebrew
Ilu	Chaldean
Indra	Vedic
Inti	Peruvian
Iodhol	Gælic
Ion	Welsh
Isten	Hungarian
Iswara	Hindu
Ishwara	Hindu
*Iunak	Slavonic
Jagannatha	Hindu
Jah	Hebrew
Jahweh	Hebrew
*Jain	Irish
*Jao	Phœnician
Jehovah	Hebrew
Jerroang	Borneo
Jesus	Romano-Hebrew
Joss	Anglo-Chinese
Juggernaut	Hindu
Jupiter	Roman
Kami	Japanese
Karwar	Papuan
Keshava	Hindu
Khoda	Persian
*Ko	Tamil
*Ku	Yucatan
Logos	Greek
Lord	English
Mahadeva	Hindu
Maker	English
Manabozho	Algonquin
Maneto	American Indian
Marang Buru	Santal
Mau	Dahomey
Maui	Maori
Melek	Hebrew
Mithra	Eranian
Mithras	Greco-Persian
Moloch	Ammonite
*Monimus	Syrian
Morimo	Bechuana
Motoro	Polynesian
Mulungu	East African
Nana-nyankupon,	Afr.G.C.
*Ndengel	Fijian
Nodens	Keltic
Nuada	Keltic
Num	Finnish
Odin	Norse
Ogmios	Gaulish
Olorun	Yoruba
Om	Hindu
Omakuru	Damara
*Omh	Keltic
Ormuzd	Persian
Osiris	Egyptian
Ove	Fijian
Perkunos	Slavonian
Perun	Slavonian
Peryv	Welsh
Phthah	Egyptian
Pillan	Araucanian
Prajapati	Hindu
Providence	English
Ptah	Egyptian
Puthen	Assamese
Quabootze	Nootka
Ra	Egyptian
Rama	Hindu
Rangi	Maori
Rheen	Welsh
Rongo	Polynesian
Ruler	English
Sabazios	Phrygian
Serapis	Egyptian
Shaddai	Hebrew
Shang-ti	Chinese
Shin.	Japanese
Shiva	Hindu
Siva	Hindu
Supreme Being	English
Svantovit	Baltic Slavoni'n
Swayambhuva	Hindu
*Tamil	Lapland
Tando	African Gold Coast
Tangeloa	Polynesian
Tengere	Mongolian
Teotl	Aztec
*Tharsco	Gothic
Theos	Greek
Thian	Chinese
Ti	Chinese
Tien	Chinese
Tinia	Etruscan
Tivi	Icelandic
Trimurti	Hindu
Tum	Egyptian
Tu-metua	Polynesian
Tupanau	Brazilian
Tuppa	Borneo
Uasar.	Egyptian
Unkulunkulu	Kaffir
Varuna	Vedic
Vasudeva	Hindu
Vishnu	Hindu
Woden	Teutonic
Word, The	English
Wuotan	Teutonic
Yah.	Hebrew
Yahweh	Hebrew
Yr Hen Ddihenydd	Welsh
Yuh-hwang	China (Taoist)
Yumala	Finnish
Zarvana Akarana	Eranian
Zeus	Greek

Capacity Measure of the Great Pyramid Coffer.

PART IV.

(Sec. 77) In the Great Pyramid, as already stated, is given the grand standard of *capacity*, by the contents or internal cubical measure, of the granite Coffer at the further or western end of the King's Chamber; and that, the final and crowning apartment of the whole of the interior of our Earth's most gigantic monument of stone.

The said coffer, however, is loose, isolated, standing on a flat floor without any guide-marks to show how it should be placed, and without the smallest hinderances (except its prodigious weight) to prevent it, in its present lidless condition, being pushed about anywhere; and except for the contraction, at one particular point in the first ascending passage way, might be pushed entirely out of the Pyramid. This point has been questioned by many, but Dr. Grant, of Cairo, accompanied by Mr. Waller, a medical man of the same place, specially looked into that matter in 1873; and settled then and there by direct and immediately successive measures, with the same scale on both the passage breadth at the indicated place, and the breadth of the coffer vessel; reporting the case as follows:. . "The coffer in the King's Chamber, although turned straight into the axis of the first ascending passage, could not have passed the *whole* way along it. Lower end of ascending passage, measured close to north end of portcullis, in British inches: breadth from East to West, across the top, or North edge, sensibly the same as the breadth of the passage itself at that point 38.38 Br. inches; breadth across middle 38.44 Br. inches; breadth across bottom, or South edge 38.12 Br. inches.

Coffer in King's Chamber.

Breadth of North end 38.62; and breadth at South end 38.75 Br. inches.

These, says Dr. Grant, "are my measures, and I can vouch for their accuracy *within* one-fourth of an inch."

That being the case, the coffer could not have been introduced by the regular passage way leading to the King's Chamber, neither can it be taken out that way now.

From the exactness with which the coffer was constructed, it is self-evident that each and every feature of it was *intended* by the ancient architect. Intended, moreover, for a further very necessary purpose; for though the coffer as a capacity measure is larger than any other standard *unit* of capacity in existence, it being *four* times the size of the English "*quarter*,"—yet one, single *coffer* measure is a very small thing to set before the whole world, and ask all nations to accept it as a standard in preference to any other box or cylinder or other shaped measure which they might have already made, or be thinking of making, for themselves.

All this difficulty was perfectly foreseen, however, by the ancient architect, as well as the possible questionings as to the authenticity and contemporaneousness of the vessel with the building of the Great Pyramid, after the thousands of years that has passed over its head. Therefore it was that he identified the coffer by certain abstruse, yet positively identifiable, scientific features with the King's Chamber in which it is placed; and that chamber, the most glorious hall that has ever yet been constructed in polished red granite, with the enormous mass of the Great Pyramid itself; and that building with the sector shaped land of Lower Egypt; and Lower Egypt with the center of the inhabited land-surface of the whole world. So that, small though the coffer may be, in itself, there cannot be another vessel of such central importance in the eye of Nature, and to the whole of mankind also, when explained.

Evidently it requires some one who has been favored with more than oridnary understanding, to explain it. Professor Smyth gives the honors to Mr. James Simpson, a young bank clerk, in Edinburgh, during the early seventies of the last century, for the most concise, and clear, mathematical elucidation yet published. As follows:—

For the full measures of all the particulars of the coffer, the reader is referred to the proceeding pages. But for convenience we will repeat the chief results here, *viz*—

OUTSIDE MEASURES OF COFFER IN PYR. INCHES.

Length, from 89.92 to 89.62 corrected for concavity of sides
Breadth from 38.68 to 38.61 corrected for concavity of sides
Height from 41.23 to 41.13 corrected for concavity of sides

INSIDE MEASURES OF COFFER IN PYR. INCHES.

Length—77.85 supposed to be true to within 1-20 of an inch.
Breadth—26.70 supposed to be true to within 1-20 of an inch.
Depth—34.31 supposed to be true to within 1-20 of an inch.
Thickness of bottom, 6.91 Pyramid inches. Thickness of sides, 5.98 Pyramid inches.

Now all these numbers are necessary to be kept in mind, for they have all a part to play in the proofs to come.

We have already shown, and Professor H. L. Smith, of New York, has independently confirmed, with regard to the coffer, taken in and by itself that—

$$\left.\begin{array}{l}\text{Exterior cubic size (In Pyr. cubic in.)} = 142{,}316 \\ \text{Interior cubic contents} \ldots\ldots\ldots\ldots\ldots = 71{,}317\end{array}\right\} = \tfrac{2}{1}\text{nearly}$$

$$\left.\begin{array}{l}\text{Also that, Sides of coffer, cubic size} = 47{,}508 \\ \text{Bottom of coffer, cubic size} \ldots\ldots\ldots = 23{,}758\end{array}\right\} = \tfrac{2}{1}\text{nearly}$$

But now for the connections with the red granite chamber, which the coffer is placed in; and with the Pyramid building itself. *By Mr. Simpson*—

(1.) "The chief line of the whole King's Chamber is geometrically its cubic diagonal, and that has been certainly now ascertained by modern measure, assisted by computation, to be equal to 515.165 Pyramid inches. (This is Mr. Simpson's base line from which he reaches up to the Great Pyramid on one side and down to the coffer on the other thus:—)

(2.) 515.165 x 10 = 5151.65 = side of a square of equa area with the Great Pyramid's vertical right section.

(3.) 515.165 = twice the greatest horizontal circumference of the coffer nearly—

(4.) $\frac{515.165}{10} = 51.5165 =$ (A.) the mean length of all the coffer's "arris," or edge lines.

= (B.) Diameter of a circle whose area is represented in the coffer's interior horizontal area *i. e.*, its inside floor.

= (C.) Side of a square whose area = mean area of the four external vertical sides of coffer

= (D.) The diameter of a sphere, whose contents (71,588) come very near those of the hollow part of the coffer, and do, in a sense, exist there.

= (E.) The diameter of a circle in which the natural tangent of *a Draconis* (the Pyramid's Polar star at the date of erection) was at its higher culmination, *viz.*, $33° 41' 20'' = 34.344$ Pyramid inches = coffer's depth.

So exactly, though extraneously, appears thus to be given the coffer's depth, that every element, which the senseless hammerings of modern travellers breaking off specimens of the material—have now very nearly deprived the world of seeing again in the body.

(5.) At the same time the external correlative of inside *depth*, namely, the *height* is given simply by the tenth part the length of the King's Chamber containing it, *viz.*, 41.213.

(6.) While the *breadth* of the coffer base is given thus, based on the number of days in the solar year:—In a circle with circumference = 365.242 Pyramid inches, the natural tangent of 33° 41′ 20″, or the Pyramid Polar star's upper culmination = 38.753 Pyramid inches = breadth of coffer's base; and again = ante-chamber's length 116.260 divided by 3.

(7) The depth and height are moreover thus related: —Depth squared : height squared :: so is area of side + end. If 103.033 Pyramid inches was found an important touchstone of commensurability in the King's Chamber, bringing out the "sums of squares there," we may expect to find it in the coffer also; where accordingly—

(8.) 103.033^2 = area of four external sides of the coffer nearly.

(9.) $\frac{103.033}{3} = 34.344$ = depth of coffer.

(10.) $\frac{03.033^2}{2\,pi}$ = height of the coffer squared."

This last theorem brings into view the invaluable quantity *pi*, which the Great Pyramid commemorates by the shape of its whole external figure. And now to that good beginning Mr. Simpson adds—

(11.) "Coffer's internal floor has a boundary whose length = the circumference of a circle of equal area to coffer's outer floor or base; a curious result this of the *long* shape of the coffer, compared with the cube, or cylinder, which it might have been for capacity measure alone.

(12.) Coffer's depth multiplied by 2 *pi* = area of East and West (*i. e.*, the two long) sides of the coffer.

(13.) Coffer's height squared = area of $\frac{\text{side} + \text{end}}{pi}$.

(14.) A circle with diameter 38.753 Pyramid inches (the breadth of the coffer's base), or again

A square with side 34.344 Pyramid inches (the depth of the coffer), has an area = the area of the external long side divided by *pi*.

(15.) Finally, if two vertical, right, sections be made through the middle of the coffer, then such are the proportions of lengths, breadths, and thicknesses, that

(A.) Area of the sections of the walls of coffer, is to area of whole section included, as 1 to *pi*. And

(B.) Area of sectional walls = height of coffer 'squared.' Then follow some most interesting correspondences, with distinctions, between these three apparently most diverse things, the pointed Great Pyramid, the enclosed King's Chamber, and the lidless granite coffer; thus—

(16.) "In each of these three structures, *one* rule governs their shape *viz.*, two principal dimensions added together are *pi* times the third.

Illustrates thus:—

In Great Pyramid, Length + breadth = *pi* height.

In King's Chamber, Length + height = *pi* breadth.

In Coffer, Length + breadth = *pi* height.

Wherefore Pyramid and Coffer have their radii vertical, and King's Chamber, horizontal."

Position of Coffer in King's Chamber.

The *position* of this remarkable vessel having been described as on a flat, smooth, unmarked floor, and that a nodule of hard jasper from the desert outside, had been pushed under one corner of the south end, and tilted it out of position; supposed to have been done (by the native Arabs) in the interest of some investigator of modern times, in search of an inscription, which was never found. But in so doing the coffer was pushed some ten inches towards the north, of where it had been intended to stand; for after subtracting that quantity from the previous measured distance, from the south wall, each distance came out just 4 feet 10.2 Pyramid inches from both the north and south walls, which distance is = the height of the Great Pyramid divided by 100.

We have, theoretically, divided the King's Chamber, transversely to its length, into two equal halves. Is anything else gained by that?

This most important illustration of the very groundwork of the claim of the coffer to be a vessel of capacity having an earth size reference.

The earth size relations then of the coffer, as deducted for itself alone, are justified by the whole King's Chamber; and the actual size is Pyramidally recognized by the lower course capacity of the chamber being 50 times the contents of the coffer, and the coffer standing on the 50th course of the masonry of the whole of the Great Pyramid from the pavement upwards. But the shape; yes, the shape of the coffer as a capacity measure—what is to justify that? John Taylor suggested, but not very strongly, "that the shape of the coffer was derived from the hot bath, the *Calidarium*, long known in the East—a long and deep box shape in which a man might lie down at full length, or sit up; and such a shape, he showed had been found more convenient for a corn holder, or large corn measure, than a cube of the same contents."

Practical Application of the Coffer in Capacity Measure.

The practical uses in capacity measure of the granite coffer in the King's Chamber, as its architect originally intended, is a vessel measuring very closely to 71,250 cubic Pyramid inches.

The whole quantity subdivides itself easily, after the manner of the Pyramid arithemetic and Pyramid construction, as follows:—the two most important steps being, *first*, the division into 4, as typifying the four sides of the Pyramid's base; and *second*, the division into 2,500, or 50 x 50 parts; fifty being the special number of the room, and the number also of the masonry courses of the whole structure on which that chamber, or rather the two adjoined chambers, rest in their places; this one, containing 10,000 000 cubic inches.

Pyramid Capacity Measure.

Division or number of each denomination contained in the whole coffer	Intermediate divisions	Capacity of each denomination in Pyramid cubic inches	Equivalent weight in Pyramid pounds of water	Name proposed to be given to each successive portion
1	0.	71,250.	2,500.	Coffer.
4	4.	17,812.5	625.	Quarter.
10	2.5	7,125.	250.	Sack.
25	2.5	2,850.	100.	Bushel.
250	10.	285.	10.	Gallon.
2,500	10.	28.5	1.	Pint.
25,000	10.	2.85	0.1	Wine glass or fluid oz.
250,000	10.	0.285	0.01	Tea-spoon or fluid dr.
25,000,000	10.	0.00285	0.0001	Drop.

The above table begins, the large measured and scientific quantity of the coffer; and ends with a unit which, in an *approximate* form as a drop (*i. e.*, the cubical space occupied by a drop of water falling freely in air at a given Pyramid temperature and pressure), is in everyone's hands, and is definable accurately upon the coffer by the stated proportion.

Pyramid Weight Measure.

Division or number of each part contained in the weight standard	Intermediate divisions	Weight of the part so divided in Pyramid lbs.	Capacity of the parts in Pyramid cubical inches of earth's mean density	Capacity of the parts in Pyramid cubical inches of distilled water T 50° B 30. of Pyramid	Name proposed to be given to each kind of part
1	....	2,500.	12,500.	71,250.	Ton.
4	4.	625.	3,125.	17,812.5	Quarter.
10	2.5	250.	1,250.	7,125.	Wey.
25	2.5	100.	500.	2,850.	Cwt.
250	10.	10.	50.	285.	Stone.
2,500	10.	1.	5.	28.5	Pound.
25,000	10.	0.1	0.5	2.85	Ounce.
250,000	10.	0.01	0.05	0.285	Dram.
25,000,000	10.	0.0001	0.0005	0.00285	Grain.

We consider the above tables an improvement on the combination measures of the United States and Great Britain; and should in time become International.

Pyramid Weighings With Reference to Specific Gravities, Temperatures and Pressures.

(Sec. 78.) Weights, then, on the Pyramid system are equally referable, as with the French system, to one given and scientifically definable, point on both the temperature and pressure scales, but when nicety is required. But that given point in the Pyramid case is an easier, pleasanter, and a better known one; while for the rough work of the world, the Pyramid weights are calculable at once from Pyramid linear measure, without any reference to observations of thermometer and barometer at the instant, much more accurately than the French can be from theirs, under similar circumstances. The Pyramid rules, too, being expressable in the following simple manner:

For small things, ascertain their bulk in cubical inches, divide by 5, and the result is the weight in Pyramid pounds, if the said articles are of the same specific gravity as the earth's average material of construction.

For *large* masses, ascertain their bulk in cubical Pyramid cubits, add ¼, and the result is the weight in Pyramid *tons*—under the same conditions of specific gravity.

But if the matter measured in either case were not of earth's mean density, but, say, ordinary stone, the real weight would be nearer a half, and if of the more common metals, double, the amount given by the above process; the raw number first procured by it, requiring for accuracy's sake, in the case of every different pyhsical substance, to be multiplied by its specific gravity *in terms of that of the earth's.* Hence, such tabular multiplier is 1 when the specific gravity is the same as that of the mean of the whole earth ball's contents; a fraction of 1 when lighter; and 1 with something added to it, when heavier; as in the follow-table, prepared from various authors:—

Pyramid System of Specific Gravites.

(Sec. 79.) Earth's mean density = 1; Temperature = 68° Fahr.; Barometric Pressure = 30.025 English inches.

Cork	.043	Desert sand, near Sphinx	.454	Lead ore, cubic	1.33
White pine (American)	.072	Aluminum	.460	Iron, wrought	1.36
Oats (loose as in bushel)	.088	Red granite (Peterhead)	.464	Copper, native	1.37
Larch (Scotland)	.093	Marble (Carrara)	.477	Steel, hardened	1.37
Lithium	.100	Red granite, Great Pyr.	.479	Brass, cast	1.37
Riga fir	.105	Emerald	.487	Manganese	1.40
Barley (loose as in bushel)	.112	Jasper	.494	Brass, cast, special	1.47
Ether, sulphuric	.129	Basalt	.500	Mercury, precipitated, red	1.47
Wheat (as in bushel)	.132	Glass, flint	.527	Cobalt	1.48
Alcohol, pure	.139	Sapphire	.550	Cadmium	1.50
Pumice stone	.160	Diamond	.618	Brass wire, drawn	1.50
Ice	.163	Topaz	.621	Nickel	1.54
Butter, tallow, fat	.165	Ironstone	.670	Copper wire, drawn	1.56
Beeswax	.169	Sapphire, special	.701	Bismuth, native	1.58
Old oak	.170	Garnet	.720	Bismuth, molten	1.72
Distilled water	.175	Ruby	.750	Silver, native	1.76
Sea water	.180	Loadstone	.843	Mercury, precipitated	1.91
Blood	.180	Silver ore	.997	Lead, molten	2.00
Heart of oak	.206	Arsenic, molten	1.010	Palladium	2.07
Cannel coal	.223	Chromium	1.04	Thallium	2.10
Aloes	.239	Tungsten	1.07	Mercury, fluent	2.38
Chloroform	.267	Tellurium	1.10	Mercury, congealed	2.75
White sugar	.282	Litharge	1.10	Gold, not hammered	2.76
Bone of an ox	.291	Uranium	1.13	Gold, hammered	2.77
Magnesium	.310	Antimony	1.17	Gold, 22 carets	3.31
Ivory	.321	Lead ore, black	1.20	Gold, 24 carets	3.38
Brick	.351	Zinc in its common state	1.21	Gold, English standard, hammered	3.40
Casing stone Great Pyr.	.367	Tin ore, black	1.22	Platinum, purified	3.42
Sulphuric acid, concen.	.373	Wolfram	1.25	Platinum, hammered	3.57
Numulitic limestone, Pyr.	.412	Zinc, compressed	1.26	Platinum wire drawn	3.60
Porcelain (China)	.420	Tin, pure, Cornish	1.28	Platinum, compressed	3.87
Glass, crown	.439	Iron, cast	1.28	Iridium	3.90
"Common stone"	.442	Iron ore, prismatic	1.29		

No efficient system, then, of determining weights by linear measure, can possibly go unaccompanied by some kind of table of specific gravities.

Harmonious Commensurability of Great Pyramid and the Earth, by Weight of the Whole.

If we desired the weights in Pyramid pounds, we should begin by taking the linear dimensions of each of the bodies in inches. But as tons are usually employed for large weights, and the weights to be dealt with are large enough in this case, we will follow that custom (our tons, however, will be Pyramid tons), and begin with the dimensions of the bodies before us, in linear *cubits*, of the Pyramid (each cubit 25 Pyramid inches long, and each Pyramid inch 1-250 millionth of the earth's semi-axis of rotation.)

GREAT PYRAMID'S LINEAR ELEMENTS OF SIZE.

(Sec. 80.)	*Pyramid Cubits.*
Vertical height of Great Pyramid...........	= 232.52
Inclined height of Pyramid face.............	= 295.72
Side of square base of Great Pyramid.........	= 365.24
Transverse thickness of ancient casing stone film	= 4.00

CUBICAL CONTENTS OF SIZE OF GREAT PYRAMID.

Cubical Pyramid cubits in the whole building, computed from the above linear elements......	10,339,850
Subtract for hollow internal spaces, such as the grand gallery, chambers, and passages, computed extraneously........................	5,250
Balance......	10,334,600
Subtract casing stone film's cubical contents =	861,952
Remains, for cubical contents of general mass..	9,472,648

All these calculations, thus far, would have to be performed on *any* system of computing weights from linear measurements, even on the French metrical system; and there, also, we should have still further to ascertain the specific gravity of the materials we are dealing with, *not one of them being the same as water.* But the casing stones, of which there are 861,952 cubical cubits, have a specific gravity (ascertained by direct experiment on hand specimens) of 0.367, where unity represents the mean density of the whole earth; while the general residual mass of the building, of which there are 9,472,648 cubical cubits, has a specific gravity, under the same circumstances of 0.412.

WEIGHT OF GREAT PYRAMID.

The conversion of the previous data into weight, proceeds thus:—

Casing stone cubical cubits.............. =	861,952
Add ¼ for Pyramid cubits.............. =	215,488
Total..	1,077,440

Multiply by specific gravity 0.367 ..... = tons	395,420
And, Residual mass in cubical cubits ..... =	9,472,648
Add ¼.	2,368,162
Total. .	11,840,810
Multiply by specific gravity = 0.412 .... = tons	4,878,414

Wherefore, 395,420 + 4,878,414 = tons 5,273,834 = weight of whole Great Pyramid.

Now let us proceed to ascertain the mass of practical weight of the whole earth.

Linear Elements of the Earth.

Polar diameter	= 20,000,000 Pyramid cubits
Equatorial diameter	= 20,070,000 Pyramid cubits
Mean of all diameters, nearly	= 20,047,000 Pyramid cubits

Cubical Elements of the Earth.

Cubical Pyramid cubits contained in the earth, computed from the above linear elements, on the usual formula depending on value of pi = 4,218,400,000,000,000,000,000.

Now to turn these cubical cubits into tons, we have merely to add ¼; for as the earth itself is its own, and the Pyramid's unit of density, the multiplyer there is simply unity. Hence—

	4,218,400,000,000,000,000,000
	+ 1,054,600,000,000,000,000,000
Weight of the earth in Pyramid tons. .	= 5,273,000,000,000,000,000,000

Comparing now this weight, with that of the Great Pyramid as given above in the same tons (5,273,834), the first four places of numbers are found to be identical; quite as close, or rather much closer, correspondence than could well have been expected; while the difference in the number of times of figures, or the number of times that the weight of the earth is absolutely greater than that of the Great Pyramid, is in the proportion of 10^{15} to 1; or, as some prefer to express it $10^{5 \times 3}$ to 1.

Now this very proportion is in peculiar Pyramid numbers, and must further be considered to have been intended.

International Appendix to Great Pyramid Weight Measure.

(Sec. 81.) *Pound Weight Measures, Different Countries.*

Country or City	Name of Weight	Weight in Avoirdupois Grains
Great Britain—United States	Pound	7,000
Portugal	Arratel or Libra	7,077
Argentine, Geneva	Libra	7,084
Lyons	Livre, poids de soie	7,088
Bolivia, Canary Islands, Chile, Cuba, Guatamala, Honduras, Manila, Mexico, Spain and Uruguay	Libra	7,098
Colombia, Venezuela	Libra	7,112
Mecca	Rotolo	7,144
St. Gall	Light Pound	7,175
Brunswick, Leipsic	Pound	7,206
Frankfort	Light Pound	7,210
Great Pyramid	*"Pound"*	7,212
Cologne	Pound	7,216
Prussia	Pound	7,218
Stettin	Pound	7,219
Wurtemberg	Pound	7,220
Dantzig, Konigsberg, Berlin	Pound	7,231
Zurich	Light Pound	7,233
Ulm, Aix-la-Chapelle	Pound	7,234
Rotterdam	Light Pound	7,243
Strasburg	Livre	7,266
Constance, Erfurt	Pound	7,285
Augsburg	Light Pound	7,295
Liege	Pound	7,330
Guiana	Livre	7,539

The above table speaks for itself; and while no one of the cities or countries enumerated, have ever adopted the exact number of grains, that the Pyramid pound is found to contain (7,212) yet, the variation of less or more is only slightly over 200 grains, or less than half of one per cent.

Linear and Surface Measure Strictly Earth-commensurable.

(Sec. 82.) The commercial arrangement of the most important of all the measures of a nation, we have now arrived at; and that one which requires parctically to be attended to first, and which *was* first attended to, and secured with more than sufficient accuracy, as well as with the grandest of suitable and harmonius earth-commensurability, in the Great Pyramid; *viz.*, linear, or length measure. And, after all that was accomplished in laying out the exterior of the building in terms of this standard, we have seen in previous sections, that the interior arrangements of the Pyramid are similarly laid out; and there, both in a harder material and in a constant temperature which brings all standards of all materials into a uniform and intercomparable condition, most unexceptionably.

The Great Pyramid's particular *standard* of length measure is, *viz.*, its 25 inch cubit, the one-ten-millionth of the earth's semi-axis of rotation, and has its length most exactly ascertainable by modern measure (combined with and understanding fromula, so as to take advantage of a multiple of the single standard arranged by the original builders, through the Architect himself), in the King's Chamber; where, as Prof. H. L. Smith has well shown, it is given with surpassing accuracy by the expression: "Cubic diagonal of the room multiplied by 10, and divided by the breadth of the floor. That is, in Pyramid inches deduced from the English inches of actual measurement, $\frac{5151.646}{206.066}$ $=25.000$ Pyramid, or 25.025 English inches.

Evidently this is the length to which, in a concrete, single, and distinctly separate shape, we were shown to exist in the granite leaf of the ante-chamber. While the granite leaf still further shows the subdivisions of a single cubit, first into five parts (25th parts of the whole cubit), which parts we will designate as "inches of the Great Pyramid."

Any one of these inches is the unit standard of the Great Pyramid linear measure. Accurately this inch is the 1-500,000,000th of the earth's axis of rotation, an inch, too, which decimally subdivided, whereon extreme accuracy is concerned.

Division or number of each part in the grand Length Standard	Intermediate division	Length in Pyr. miles	Length in Pyramid cubits	Length in Pyramid inches	Name of each division
1		4000.	10,000,000.	250,000,000.	Earth's half breadth or semi-axis of rotation
1,000	1000.	4.	10,000.	250,000.	League.
4,000	4.	1.	2,500.	62,500.	Mile.
40,000	10.	0.4	250.	6,250.	Furlong.
100,000	2.5		100.00	2,500.	Acre-side.
1,000,000	10.		10.	250.	Rod.
10,000,000	10.		1.	25.	Cubit.
(4,800,000	......		0.48	12.	Foot.)
250,000,000	25.			1.	Inch.
2,500,000,000	10.			0.1	Tenths.
25,000,000,000	10.			0.01	Hundredths.
250,000,000,000	10.			0.001	Thousandths.

A small standard, viz., the foot of 12 inches is left in place; because, although not evenly earth-commensurable, and inappropriate, therefore, for scientific purposes, there is a large operative use for it; and it is connected at one end, though not at the other, with the Pyramid system. And if we next compare all the mutually approximating Pyramid items with the British, and in terms of present English inches (so that we may not be speaking in an unknown tongue), we shall have the following table:—

Pyramid and English Linear Measure.

Compared through the temporary medium of English linear inches.

Pyramid Inches.		*English Inches.*	
1 earth's semi-axis of rotation.. =	250,250,000,000		
1 league........ =	250,250.000	1 league........ =	218,721.600
1 mile.......... =	62,562.500	1 mile.......... =	63,360.000
1 arce-side..... =	2,502.500	1 acre-side..... =	2,504.525
1 rod.......... =	250.250	1 rod.......... =	198.000
1 cubit........ =	25.025	2 foot rule...... =	24.000
1 foot......... =	12.012	1 foot.......... =	12.000
1 inch......... =	1.001	1 inch......... =	1.000

International Appendix to Great Pyramid Linear Measure.

"Cloth Measure," Close to Pyramid Cubit.

Country or City	Name of Linear Measure	Length in English Inches
Algears	Turkish pic	24.53
Ancona	Braccio	25.33
Bergen, Copenhagen	Ell	24.71
Betalfagui, Basoria, Mocha	Guz	25.00
Bologna	Braccio (Woolen)	25.00
Candia	Pic	25.11
Egypt	Derah	25.49
Ferrara	Braccio (Silk)	24.75
Great Pyramid	*"Pyramid Cubit"*	25.025
Mantua	Braccio	25.00
Moldavia, Roumania	Kot	24.86
Nancy	Aune	25.18
Padua	Braccio (Silk)	25.30
Parma	Braccio (Cloth)	25.10
Patras	Pic (Silk)	25.00
Persia	Guerze	25.00
Smyrna	Indise	24.65
Trieste	Ell (Silk)	25.22
Tunis	Pic (Silk)	24.83
Venice	Braccio (Silk)	24.81
Verona	Braccio (Silk)	25.22
Zante	Braccio (Silk)	25.37

Thermometers and their Scales in Different Countries.

(Sec. 83.) A "thermometer" in this enlightened age is one of the most widely essential of all scientific instruments and there is probably no modern science which can advance far without its aid.

Prominently connected with *thermometers* is the name of "Mynheer Gabriel Daniel Fahrenheit," who was born at Hamburg as some say; at Dantzig, according to others; while all allow that he afterwards lived at Amsterdam. Exactly *when* his birth took place is not known, nor is the date of his death, but his "Dissertation on Thermometers" was published in London in 1724, not many years after the first successful introduction of quicksilver, to take the place of air, in thermometers; and seems to have been the chief agent, over and above his own practical success in the manufacture of such thermometers, in causing his system of numbers and scale-graduations to become such an almost universal favorite in England. And yet it is now alleged that Fahrenheit was not the original inventor of the scale which bears his name; that having been really divised and first used by Olaus Roemer, the celebrated astronomer of Copenhagen, about 1709. Touching absolute cold, is seen every winter to be a mistake, whenever his thermometer descends below its own carefully marked zero; while the all-important point of the freezing of water is left at the not very signal, but certainly rather inconvenient number of 32°; and the boiling point at the not more convenient one of 212°.

Many, therefore have been the demands that either the German Reaumur, or the French Centigrade should be adopted; in terms of any of which, water freezing marks 0°; and all degrees below that notable point are nagative; above, positive.

As a greater number of states of temperature are generally demanded, between the freezing and boiling points, why not adopt the 250 of the Great Pyramid scale? For, by so doing, not only will the world's population reap that one advantage above mentioned, to a still greater extent, but they will suffer less shock, as it were, in their feelings, when talking of summer temperatures, than even if they retained the Fahrenheit degrees, but placed at 0° at freezing; as simply illustrated by the following numbers giving the absolute temperatures in terms of five different thermometric scales:—

Fahrenheit	Mod. Fahrenheit	Centigrade	Reaumur	Pyramid
122°	90°	50°	40°	125°
104°	72°	40°	32°	100°

The Pyramid system which so often ends with reference to the four sides of its base, again comes to our aid in the fixing of temperatures. Multiply, therefore, the 250° (of water-boiling by 4, making 1,000°; at the notable and dividing line of heat, where it causes bodies to begin to give out light. Again, multiply this 1,000 by 5 (a Pyramid number) and we have 5,000° of the Pyramid, or that glowing white-hot heat, where the chemists of the different nations would place the melting point of the most dense and refractory of all metals, platinum. Or descend again to —400° Pyramid, and we find a point regarded by some existing chemists as the absolute zero of temperature.

The French metrical temperature reference was originally intended by its scientific authors, admirable for their day, to have been the freezing point for water; on the arithmetical and mathematical, rather than physical and experimental, conclusion—that they would find water in its densest condition when coldest, or immediately before passing into the state of ice. But when they began to experiment, nature refused to be bound by human ideas, and water was discovered to be of the greatest density at a very sensible distance of heat above freezing, or at 39.2° Fahr.

But all these anomalies are corrected at once at the Great Pyramid; for its position on the earth's surface in that parallel of latitude (*viz.*30°) which, by the geometry of a sphere, has an equal amount of terrestrial *surface* between itself and the equator on one side, and itself and the Pole on the other, evidently points to something like mean terrestrial surface temperature as the proper central point of comparison in the affairs of men. Equally, too, does the Pyramid point to 30 of its inches of mercurial pressure of the atmosphere, as the international reference in that department of Nature. Exhibiting the quantity also as the very clear and distinctly separating line between good and bad of the weather all the world over; above 30 inches of the barometer meaning dry weather, sun-shine and bracing Polar air; below 30 inches, rain, clouds moisture and electric equatorial gales.

The Pyramid reference indeed for pressure would not be exact, if observed very scientifically and microscopically in its own latitude and longitude *at the sea level.* But that low down reduction of all materiologists, is only another case of their going on one side, instead of to the middle, of the fact; for the bulk of mankind does not live at that most dangerous level, where the record of the "tidal-wave" tells its own story—but at such a mean and perfectly safe height above it, as that of the King's Chamber of the Great Pyramid, *viz.*, 4,297 inches (or 358 ft. 1 inch) A height which both gives out, on an annual mean of barometric observations, the required 30 inches; and at the same time makes the temperature observed there, under normal circumstances, the true Pyramidal 1-5 between boiling and freeing of water; and not the slightly higher temperature of that latitude and longitude, if reduced to what does not exist there the sea-shore and its level.

TEMPERATURES IN PYRAMID THERMOMETER DEGREES.

(Sec. 84.) *Atmospheric pressure = 30 inches, except when otherwise stated.*

Platinum melts	5000	Mercury boils	882
Wrought iron melts	4000	Mercury boils	875
Wrought iron melts	3750	Sulphuric acid, strong boils	845
Steel melts	3500	Sulphuric acid boils	812
Steel melts	3250	Lead melts	815
Cast iron melts	3875	Cadmium melts	788
Cast iron, grey, melts	3130	Phosphorus boils	725
Cast iron, white, melts	2625	Bismuth melts	575
Gold, pure, melts	3125	Water boils under 20 atmospheres	535
Gold, alloyed as in coinage	2950	Under 15 atmospheres	500
Copper melts	2875	Under 10 atmospheres	450
Silver, pure, melts	2555	Under 5 atmospheres	381
Silver, pure, melts	2500	Spirit of Turpentine boils	325
Bronze melts	2250	Acetic acid boils	290
Sulphur boils	1100	Sulphur melts	278
Antimony melts	1080	WATER BOILS	250
Zinc melts	1028	Sodium melts	238
Zinc melts	900	Benzol boils	200
Iron visible in the dark	1000		

Alcohol, pure, boils	198
Alcohol, pure, boils	195
Stearic acid melts	174
White wax melts	170
Wood spirit boils	166
Potassium melts	158
Yellow wax melts	155
Greatest observed shade temperature	139
Stearine melts	138
Spermaceti melts	122
Summer temperature at Great Pyramid	100
Ether, common, boils	92
Blood heat	91.5
Butter and lard melts	82
Mean temperature at level of King's Chamber in Great Pyramid	50
Pyramid temperature—T $\frac{1}{5}$ *Mean temperature of all lands inhabited by man, and temperature of the most suitable degree to man*	50
Ether boils	28
Mean temperature of London	25
Low winter temperature at Great Pyramid	20
Water freezes	0
Freezing mixture, snow and salt	—50
Sulphuric acid freezes	—87
Mercury freezes	—98
Greatest cold experienced	—125
Greatest artificial cold, nitrious oxide and carbonic disulphide, *in vacuo*	—350
Absolute zero (Miller's Chemistry	—400
Theoretical base of air thermometer; or air supposed to be so excessively contracted in bulk by cold, as at last to occupy no space at all, and in that case to become of infinitely great specific gravity	—682

PYRAMID ANGLE MEASURE.

(Sec. 85.) Astronomical scientific development, feels the necessity, and demands an angular, as well as a linear measure to refer to for distances; while the same demand for angular measure is experienced in each of the purely terrestrial sciences as well.

The French *savants* of the Revolution attempted to introduce into their decimally arranged metrical system an *angular* graduation where the quadrant contained 100, and the whole circle 400, degrees. But, after trying it for some years, they had to give it up; for it seems the influence of "Great Babylon," which is, by many persons, believed to have originally invented, and then fixed on the world, our present sexagesimal system, or 360° to the circle, and 60′ to the degree, was too powerful for the then, mathematicians of Paris, to contend successfully against.

But there could have been no more community feeling among the Babylonians, and the extreme ancient Builders of the Great Pyramid in their goniometry, than in their methods of astronomical orientation, which we have already seen were entirely diverse. What system, then, for angle was more probably employed at the Great Pyramid?

A system, apparently, of 1000° to the circle; 250° to the quadrant. This conclusion has been ventured, by prominent Egyptologists, to be deducted from the following features at the Pyramid:—

(a.) The angle of rise of the Pyramid's flanks, and the angle of descent or ascent of its passages, are both very peculiar angles, characteristic of the Great Pyramid; and though rough and incommensurable on either the Babylonian, or French, or any known angular system, are in a practical way evenly commensurable on the Pyramid system.

Pyramid Feature	System of Angle Measures			
	Babylonian	French	Vulgar	Pyramid
A whole circumference	360°	400°	32°	1000°
Angle of side with horizon	50° 51′ 14″	57°.62	4°.61	144°.05
Angle of passages.....	26° 18′ 10″	29°.23	2°.34	73°.08

(b.) Whereas the King's Chamber has been in a manner utilized as the chamber of the standard of 50, and the Queen's as that of the standard of 25, and are both of them witnessed to by the number of Pyramid courses on which they stand, the subterranean chamber may be considered the chamber of angular measure; and does, at its center, view the whole pyramid side, at an angle of 75° 15′ 1″ Babylonian, but 209°.03 Pyramid. And though there are now only 202, there are shown to have been in the original finished Pyramid somewhere between 209 and 218 complete masonry courses; or agreeing within the limits of error of those researches, with the angular result of 209°.

(c.) And then there follows a useful practical result to Navigation, and its peculiar itinerary measure, the 'knot,' or nautical, or sea-mile; *viz.*, the length of a mean minute of a degree of latitude.

At present there is much inconvenience from the large difference in the length between our land and sea miles; for they measure 5,280 and 6,085.88 + feet respectively. (See index for length of statute and nautical mile compared.) But granted that a Pyramid *knot* shall be 1-25th part of a Pyramid degree, then the respective lengths of a Pyramid land, and a Pyramid sea, mile will be the comparatively approaching quantities, in inches, of 62,500 and 62,995.

MONEY. (WHY NOT PYRAMID MONEY?)

(Sec. 86.) Many inquirers have demanded, "What about money on the Pyramid system?"

Nothing whatever has been discovered up to this date (except coincidence) that has coupled the subject of money with the Great Pyramid. And, no wonder, for no one has as yet defined exactly, what money is.

The nearest approximation to the subject (we have ever seen) we think is, in a small volume entitled "A Thirty Years' War on Silver," by Supreme Judge Fitsgerald, of the State of Nevada. Look at any piece of (coin) money whatever: whose image and superscription does it bear) That of some earthly Cæsar or other. None of the present or past coinages, with which we are familiar, have any fixed weight or measurement, relative to any *other* fixed weight or measurement; with the single exception of the "5 cent *nickel*" of the United States, which is: "a millimetre in thickness, and is said to weigh 15 grammes," in its relation to the "French metric system." The following *astonishing coincidence*, however, is worth quoting; given to the world by Dr. Watson F. Quinby, of Wilmington Delaware, some forty years ago, as follows:—

"Our (U. S.) silver coinage corresponds in grains to the measures of the King's Chamber in the Great Pyramid, in English inches. So that the length of that chamber being

412.5 of those inches, the standard weight of the "Dollar of the Fathers" is 412.5 grains; the half-dollar, weighing 206.2 grains represents the breadth of the same chamber—206.25 English inches; and the quarter-dollar of 103.1 grains represents in inches the half breadth of the same chamber, or the 'touch-stone' length as it has been called of so many of the Great Pyramid's measurements.

"At the same time the grander golden coin, the American Eagle, contains 232.5 grains of pure gold, or the number of Pyramid cubits in the vertical height of the Great Pyramid; and the 'half-eagle' contains 116.25 of the same gold in grains, equal almost exactly to the length of the Ante-Chamber of the King's Chamber in the same Pyramid expressed in Pyramid inches."

TRANSCENDENTALISMS OF GREAT PYRAMID ASTRONOMY

[By Prof. Piazzi Smyth, R. A., with comments by the author.]

(Sec. 87.) "Now the only source from whence one uniform system of siderial chronology, and which, though endued with *some* change in respect to the seasons, yet alters so slowly year by year and generation after generation as to require 25,827 years before it passes through all the seasons—the only source, I say, from whence it could have emanated in that early age of the world, and have been impressed upon the *origines* of all races of mankind, is, was, and ever will be, Divine inspiration; and the Divine intention touching that mystery of God, the human race on earth.

"But not by any means implying that the terrestrial human race is the only object cared for by God, throughout all the siderial universe. For had it been so, they might have been created for man's chronological purposes alone—instead of man being taught, as in this case, to make the best practical use of pre-existant, pre-created means. Here, accordingly, what we are called upon to note, may rather remind us of that which Josephus records of the descendants of Seth, *viz.*, that no creation miracles were wrought for them, but that they, though favored with Divine assistance, had to study astronomy in the laws of the stars as they already existed. And pushing our calculations to the extreme of modern science, we shall undoubtedly find that those stars were by no means in themselves absolutely perfect for this one end alone. But take them as they were 4,000 years ago, and after they had been already set in motion by the divine power æons and æons of ages before the Pyramid day—and you will find that they did, at that epoch, come quite near enough to form an excellent practical chronological system of the kind indicated; and no better mode of utilizing those actual phenomena of the starry sky, nor any better choice among the stars, ever has been imagined since then, in any country of the world.

Thus, to moderate observation (and with far greater accuracy than the annuals of the profane history of mankind have been kept to) all these hereinafter-following features may be said, in *ordinary* terms, to obtain—

1. The Great Pyramid is astronomically oriented in its sides; and its passages are in the plane of the meridian.

2. The entrance passage, with its alt. angle of 26° 16′ nearly, points 3° 42′ vertically below the Northern Pole of the sky.

3. In the year 2170 B. C., *a Draconis* was 3° 42′ from the Pole of the sky, and therefore looked down the axis of the entrance passage, when at its *lower* culmination.

4. When *a Draconis* was so looking down the entrance-passage in the North, then *Tauri*, the chief star in the Pleiades group, was crossing the local terrestrial meridian, towards the South; in the vertical plane of direction of the Grand Gallery, but at a point high up in the sky, near the equator.

5. At the same moment of that year, 2170 B. C., the celestial meridian of the Vernal Equinox also coincided with that same *Tauri* star, and gave it for the time an extraordinary, chronological, super-eminence over all others.

6. That whole stellar combination had not taken place for 25,827 years previously, and will not take place again for 25,827 years subsequently. It has not consequently repeated, or confused, itself yet in all the history of the human race; through the Sothiac cycle, the Phœnix cycle, and other chronological inventions of the profane Egyptian priests, men long after the Pyramid day, and supposed generally to have been the most learned of the ancients—have done so again and again; to the lamentable confounding of dates in the old Pagan, and modern Egyptological world too."

NOTE.—It will be observed in the above quotation, that Professor Smyth reaches back in his astronomical calculations, *nearly 30,000 years*, but he does not go back with his dates, "*to the first advent of man upon the earth*" beyond 4,004 B. C., thereby, rather mixing his theory, of the "4th day of Creation," as recorded in the first chapter of Genesis. Again he says:—

"But if the calculations on which the above Pyramid results are founded, shall be pushed to much greater refinement, or to proportions of space invisible to the naked eye,—it then appears that (1.) the Pole star, when it was $3^{\circ}\ 42'$ from the Pole, (2.) the equatorial star opposite to it, and (3.) the celestial meridian of the equinox, were not all of them on the Pyramid's meridian, below and above the Pole, *precisely* at the same instant, either in the year 2170 B. C., or in any other year.

But this difficulty is not by any means entirely dependent on the stars, in their places, not being as exact as if they had been created originally for no other than the above purpose; for there are hindrances also to modern astronomy, in precisely realising every simple thing in number, weight, and measure, that has taken place in Nature dnring the last 4,000 years. Two astronomers, for instance, using the same data, may compute back the place of a given star 4,000 years ago from its present place, and they shall agree to a second in the result; but it does not therefore follow that the star was precisely there at that time, as though a contemporary astronomer had observed it then; because proper motion, and variations of proper motion, may exist, quite unknown to the short period of surveillance over the second in the result; but it does not therefore follow that the star was as precisely there at that time, as though a contemporary astronomer had observed it then; because proper motion, and variations of proper motion, may exist, quite unknown to the short period of surveillance over the stars yet enjoyed by modern astronomy. Some of the quantities too, of the celestial mechanics concerned ,such as the precise amount of the very precession of the equinoxes itself, and its accompanying phenomena of nutation and aberration, may have been erroneously assumed, and never can, or will be ascertained perfectly by man. The accepted numerical values of such quantities do, in fact, vary at the same time between one astronomer and another (unless both were brought up in the same school, and then both may differ from truth), and also between one generation and another of astronomers in the same place.*

[At the request of Prof. Smyth, in 1871, Dr. Brunnow, (then Astronomer-Royal for Ireland,) prepared the following table on the Pyramid star calculations], viz.—

(1.) "*a* Draconis was for the first time (†)at the distance of 3° 41′ 50″ from the pole in the year . . . . = 3443 B. C.

(2.) "It was at the least distance from the Pole, or 0° 3′ 25″, in the year . . . . = 2790 B. C.

(3.) "It was for the second time at the distance of 3° 41′ 42″ from the Pole in the year . . . = 2136 B. C.

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* Viz—Astronomers even of 40 years ago are no longer quoted authoritively; for it is found that the theories of Mercury, Jupiter, Saturn, Uranus and Neptune, are all in need of revision. The Tables of the Planets by Professor M. Le Verrier, and Newcomb, differ materially from present observations.

† How did he *know* that it was there for the *first* time?

(4.) "*Tauri* (Alcyone of the Pleiades) was in the same right ascension as the equinoctial point in the year .... = 2248 B. C. when it crossed the meridian above the Pole 3° 47′ north of the Equator, with *a* Draconis crossing below the Pole, nearly but not exactly at the same instant; and *a* Draconis was then nearly 90° (89° 16′) from Alcyone in the meridian, measured through the Pole.

(5.) "*a* Draconis and *Tauri* were exactly opposite to each other, so that one of them could be on the meridian above the Pole, and the other on the meridian below the Pole at the same absolute instant, only at the date of .... = 1574 B. C. but when all the other data diverged largely.

"We have now to deal with the last three dates. Of these three, the first two evidently include between them my own previous quantity of 2170 B. C.; but the third differs extravagantly. Nevertheless, the visible effect in the sky of that one apparently very large difference in absolute *date*, is merely this, according to Dr. Brunnow's computation; *viz.*, that when *Tauri*, or the Pleiades, were crossing the meridian above the Pole, at my Pyramid date of 2170 B. C., *a* Draconis was not doing the same thing, *exactly* beneath the pole, at the same instant; for the star was then at the distance of 0° 17′ *west* of the meridian. But it would have been doing the same thing perfectly, according to *an entrance-passage observation of it*, if the northern end of that passage had been made by the builders to trend 17′ westward, still keeping to its observed angular height in the vertical plane; *viz.*, 26° 18′.

"Whereupon comes the question whether—granting temporarily that Dr. Brunnow's excellent calculations in modern astronomy replace everything that has happened in Nature during the last 4,000 years—whether that 17′ of the Pole star's *west* distance from the meridian was a thing of moment;—and if so, is this the first occasion on which the divergence has been discovered?

"Seventeen minutes of space, or less than the thousandth part of the azimuthal scale, is but a small quantity for any one to appreciate in all the round of the blue expanse, without instruments; and the first effort of Greek astronomy 1,800 years after the Pyramid was built, [? how did he, or how does any other human being, living, know just *when* it was built?] is reported to have been the discovery that the Pole star of that day, then 6° from the Pole, was not as *they*, the Greeks, had previously held, *exactly* on the Pole. Greek and other profane nations, then, had been in the habit of overlooking, long, long after the epoch of the Pyramid, an error twenty times as great as this which is now charged on the Great Pyramid astronomy, by the present day science of precision, which has been at last elaborated amongst men after a further consumption of 4,000 years.

"And yet it was not all error either, on the part of the Great Pyramid. For here we should take account of the results of my observations in 1865, when I succeeded in comparing the directions of both the outside of the Pyramid, the internal axis of the entrance passage, and the axis of the azimuth trenches separately and successively with the Polar star. These observations were made with a powerful altitude-azimuth instrument, reading of its angles with micrometer-microscopes to tenths of seconds; and the conclusions from them were, that everything at the Great Pyramid trended, *at its, north end towards the west*—the azimuth trenches by 19 minutes, the socket side of the base by 5 minutes, and the axis of the entrance passage by more nearly 4 minutes and a half. What *could* all these features have been laid out for with this slight tendency to the west of north? was a question which I frequently pondered over at the Great Pyramid, and sometimes even accused the earth's surface of having shifted with respect to its axis of rotation during 4000 years. But now the true explanation would appear to be, that the Seth-descended acrhitect, knowing perfectly well the want of exactly the 12 hours, or 50 inch, correspondence between his Polar and Equatorial stars (though they were the best in the sky), had so adjusted in a minute degree the position of the Great Pyramid when building it, as to reduce any error in his Pleiades system of chronology arising out of the stellar discrepance, to a *minimum*. Whence the fact of the *western* divergence of the north pointing of the entrance-passage, as detected by the modern astronomy observations in 1865, combined with the computation in 1871—becomes the most convincing practical proof of intention, and not accident, having guided all these time arrangements of the Great Pyramid.

"On discussing recently with some of the astronomers who were sent to Egypt in December 1874, to observe the Transit of Venus (ns a stepping stone toward attaining a knowledge of the sun distance)—the palm of merit for the best time observations seemed to be unanimously accorded to those of them who had adopted a new method of using their transit instruments, recently elaborated by M. Otto Struve, of the Central Russian Observatory; and which consisted in observing, not exactly in the plane of the meridian (as usually done or tried to be done), but *in the vertical of the Pole star at the instant;*—or, as nearly as possible, on the very method of ultra-refinement adopted at the ancient Great Pyramid. Hence the object of this chapter is now fully obtained: for not only does the ancient monument fix an absolute date for itself, *viz.*, something very close to 2170 B. C., which all the profane monuments were confessed to be incapable of even approximately attempting, but it does so by methods unknown of old elsewhere, and only recently begun to be appreciated in the best *European astronomy.*"

The foregoing copious notes, from Professor Smyth's final effort, before he passed to the beyond, in his attempt to fix the date of the building of the Great Pyramid, is one of the best efforts of his life, and is indicative of the man. He was a *noted astronomer* and *mathematician*, and wrote *nothing* but what he thoroughly believed to be true. But his science was narrow, and warped, at times, in his vain attempt to *prove*, that a "Deified Atchitect" directed the building of the Great Pyramid, in the year 2170 B. C.

With the perfect mechanical skill which he knew was necessary, to construct the inner, finished portions of the Great Pyramid; and the mathematical and astronomical intelligence requisite for its architect to lay out and plan such a building, his knowledge of past history taught him:—that no such individual, or set of individuals had preceeded our present scientific age, within the last 6,000 years, or even existed today.

And with his further belief, (and to *him*, *knowledge*) that this earth of ours was only about 5,883 years old in the year 1879 A. D.; it was perfectly natural that he should not only suggest, but *believe* that the Architect was gifted with Deific intelligence. But in his great enthusiasm for his *Deified Architect* he neglected to apply that same term to the mechanics and laborers on the Great Pyramid, which were certainly—equally necessary. That the Great Pyramid is the most perfect building in the world for a "Depositary of Weights and Measures," geographically, astronomically and mathematically, every person who has read up the subject must confess. And, every Fraternal man, no matter as to what organization he represents, must also acknowledge its perfect adaptability, as an asylum or lodge outfit.

But just what use it could be to religious worshipers, we are at a loss to know, and Professor Smyth has not informed us. For, as a matter of course, if its architect was *Deified*, it was for a purpose; and, that purpose should stand out somewhere in that *grand structure*, to point out one "God," or the "Father and Son"; or, Heaven, and Hades. But, no such significence has been pointed out, by *any Egyptologist* as existing therein.

Our theory therefore, comes to the front. For, as no human being has appeared upon the face of the earth in the record of history; or that can be found today in the whole civilized world, that would be egotistical enough even to *assert:* that he could plan, and cause the erection of a similar structure, as that of the Great Pyramid Jeezeh; therefore, as the building *really* exists, somebody must have been the architect, and some body of intelligent human beings must have assisted him in its erection. Who were they?

Let us reason together. The earth is proven to have been several millions of years in existence, by both geology, and *astronomy.* If that is so, will any one attempt to argue in this enlightened age, that is has only been peopled for 6,000 years? Suppose in minimum figures, that the earth has stood just 1,000,000 years; and that it has been inhabited, off and on, for one-fourth of that period, or 250,000 years; and that during some one of those inhabited periods, the geneology existed through more than 50,000 years; could not *they* as a race of people, have gained more knowledge, general intelligence, scientific and mechanical skill, in 50,000 years, than we have stored up in our little insignificant 6,000 years? The internal fires of the earth, and the changing of the earth's polarity from various causes, has caused most of the continents to change places with the waters of the earth, many times, but at long intervals. During some one of these long inhabited periods, the wise men of their day, *discovered'* that there was a small peice of territory located near to 30° N. Lat., and 31° 10′ 1″ E. Lon. that would not again change places with the watery deep, for at least 500,000 years. On this spot they erected that "Great *First Wonder of the World,*" that has kept our geology guessing for over 5000 years. We have in a previous section of this work stated, the purpose that led to its erection. Before closing this volume we will picture one of the 'degrees' taken in this asylum over 50,000 years ago. But first, a little more conservative information in measurement and capacity.

THE ARK OF THE COVENANT OF MOSES.

(Sec. 88.) The size of that Ark-box of Moses is given in the Old Testament as being $2\frac{1}{2}$ cubits long, $1\frac{1}{2}$ cubits broad, and $1\frac{1}{2}$ high; which measures being reduced to Pyramid inches, on Sir Isaac Newton's valuation of the sacred cubit of Moses, $= 62.5 \times 37.5 \times 37.5$ of those inches.

But was this outside measure or inside measure? for that must make a very material difference in the cubical result.

Outside measure, without a doubt, and for the following reasons:—

Because the vertical component is spoken of as height, and not depth; and because the lower lid of gold, or the Mercy-seat, being made only the *same* stated length and breadth as the Ark itself, it would have stood insecure, and run a chance of tumbling down to the bottom of the box, if that length and breadth had signified the top of the box's inside, and not its outside area. Scripture does not inform us just what thickness the sides were, and therefore we do not know exactly how much to subtract from the outside, to give the inside dimensions; but the outside having been given, and the material stated, the limits within which such thickness must be found are left very narrow indeed. Let the thickness, for instance, be assumed to be 1.8 Pyramid inches; then the length, breadth, and depth will be reduced from an outside of $62.5 \times 37.5 \times 37.5$ to an inside of $58.9 \times 33.9 \times 35.7$; which gives 71,282 cubic inches for the capacity contents of this open box without a lid.

Or, if we place the sides and ends at 1.75 inch in thickness, and the bottom at 2 inches—which are very fair proportions in carpentry for such a sized box in such a quality of wood, as that from which it was constructed,—then its inside measure would be $59.0 \times 34.0 \times 35.5$; which makes the cubical contents=71,213 cubic inches. Which makes it almost identical with the capacity of the coffer in the King's Chamber of the Great Pyramid; or within 0.37 of a cubic inch.

The brazen lavers of Solomon's Temple were also of the same cubic capacity as the coffer in the Great Pyramid; and measured on the Hebrew system 40 baths or 4 homers; while each of those *homers* was of equal value in capacity as the Anglo-Saxon 'quarter,' used for corn measure amongst that people.

Solomon's Molten Sea.

(Sec. 89.) This vessel, by name the "Molten Sea" was cast in bronze, though of a shape and size which have defied all essayists hitherto to agree upon. Even in the Bible, something of what is said there about it, is stated variously in different books thereof, as in that of Kings, the cubical contents are given as 2,000 baths, while in Chronicles they are set down as 3,000. As the latter is only fragmentary, we will take the former statement; and then find that the statement in baths, that the 'molten sea' would have contained the contents of a laver 50 times; or a Pyramid number at once.

In I. Kings, VII. 23-26, we are told that the 'molten sea' "was ten cubits from one brim to the other; it was round all about, and its height was five cubits; and a line of thirty cubits did compass it round about and it was a hand's-breadth thick."

To realize the shape is the first point. Some devout students have imagined it cylindrical; some of a swelling cauldron form, but the greater numbers, a hemispherical shape; and this, perhaps, is most agreeable (1.) to the phrase "round all about," (2.) to its diameter being twice its height, and (3.) to the traditionary testimony of Josephus that it *was* hemispherical.

If this point is settled, are the measures given, of the inside, or outside denomination? By the rule established for the Ark, the breadth and *height* are outside, of course; but in that case, what is the meaning of a circle of 10 cubits in *diameter*, having a *circumference* of 30 cubits? That is a total impossibility; and wholly against the principal measurements of the Great Pyramid itself, which proves in various ways that the circumference of a circle having 10 for diameter, cannot be less than 31.4159, etc.

We conclude therefore, (as an indication of the thickness of the vessel is given, *viz.* at a hand-breadth) that the *inside* circumference was alluded to, but the *outside* diameter.

A hemisphere, then, with an inside circumference of 30 Pyramid cubits, its diameter would be 238.73 Pyramid inches, giving, with an outside diameter of 10 cubits, nearly 5.5 inches for thickness (or the space which the hand of a strong man spread out would easily cover). The cubic contents, then, of such internal hemisphere will be 3,562,070 Pyramid cubit inches; and divided by the Pyramid number of 50, give 71,241 of the same cubic inches; *i. e.*, within a seven-thousandth part the same as either the Ark of the Covenant, or the Coffer of the Great Pyramid.

Solomon's reason for making his "molten sea" 50 times larger than his already large brazen vessels, the lavers, was most probably occult; and used only for the purpose of demonstrating some of the mysteries of the great *Unknowable*. Think of it, this "molten sea" of Solomon's had a capacity of over 15,420 U. S. gallons; could it have been used for storing corn, wine or oil?

The cubit used by Solomon at the building of the Temple being also of the sme 25 inch, and earth-commensurable, length as that employed by Moses on the Tabernacle in the Wilderness; and that again identical with the cubit chiefly monumentalized in the design of the Great Pyramid; yet we have been obliged to conclude that Moses, though he lived long in Egypt, could never have been inside of the Great Pyramid, and had, therefore, no opportunity of *humanly* copying the cubic contents of the coffer; or supplying himself with a note of the length of its cubit; vastly more certain may we be that King Solomon was never inside the Great Pyramid either, or in a position to note the exact amount of cubic contents of the lower course of the coffers' containing chamber, or to copy the Pyramid cubit length and its subdivisions from the granite leaf in the a te-chamber.

Whence, then, came the metrological ideas common to three individuals in three different ages; and involving reference to deep cosmical attributes of the earth, understood by the best and highest of human learning at none of those times? We leave the subject with you.

ARE THERE OTHER ROOMS STILL UNDISCOVERED WITHIN THE GREAT PYRAMID?

(Sec. 90.) Modern quarrying into this, nearly solid structure, at different periods, is evidence on its face, that the delvers into this massive structure, expected to discover other open space. And, as only about 1-2000th of the whole mass, is found to be open space, it is not to be wondered at; and we believe it, as we have previously stated.

Several important personages have delved into the floor of the Queen's Chamber, in years past, expecting to find a passageway leading to the "Sphinx." While we firmly *believe* that such a passage way exists, we think it will be found to enter somewhere beneath the N. E. corner. As the "Sphinx" is located about three-fourths of a mile away from the S. E. corner of the Pyramid, the passage way would have to run in a circuitous course and quite deep down to enter the building at the point we have suggested.

Everyone has read or been told the story of Caliph Al Mamoun, after blasting his way from the middle of the northern side into the solid fabric of the Great Pyramid for six weeks, was just about to give up the research when he heard a stone fall in a hollow space close on one side and breaking on further in that direction, he presently found himself in the entrance passage; while the stone which had fallen at that precise instant, was a *prism*-shaped block that had been anciently inserted in the ceiling. While the space to be filled up by the base of the stone is square, the two sides parallel with the walls of the passage require to be triangular, on account of the angle, at which the bottom of the portcullis block of the ascending passage meets the ceiling, of this entrance and descending passage prismoidal shape meets the case exactly. Professor Smyth asks:—

"Would that first ascending passage, then, *never* have been discovered, if that faithless, perhaps timerous, block had not fallen out, whether in Al Mamoun's or any other day? Let the following facts indicate:—When measuring the cross joints in the floor of the entrance passage in 1865, I went on chronicling their angles, each one proving to be very nearly at right angles to the axis, until suddenly one came which was *diagonal*; another, and that was diagonal too, but after that the rectangular position was resumed. Further, the stone material carrying these diagonal joints was harder and better than elsewhere in the floor, so as to have saved that part from the monstrous central holes and ditches perpetrated in other parts of the same inclined floor by some moderns. Why then did the builders change the rectangular joint angle at that point, and execute such unusual angle as they chose in place of it, in a better material of stone than elsewhere; and yet with so little desire to call general attention to it, that they made the joints fine and close to such a degree that they had escaped the attention of all men until 1865 A. D.?

"The answer came from the diagonal joints themselves, on discovering that the stone between them was *opposite* to the butt end of the portcullis of first ascending passage, or to the hole whence the *prismatic* stone of concealment through 3,000 years, had dropped out almost before Al Mamoun's eyes. Here, therefore, in a peculiar relation of position to something concealed, was a secret sign in the pavement of the entrance passage, appreciable only to a careful eye and a measurement of angle, but made in such hard material that it was evidently intended to last to the end of human time with the Geat Pyramid, and *has* done so thus far."

Again the Professor is at sea, and lost both as to his reasoning, and to account for another hidden mystery; our answer is:—that this is one of the doors, or inlets, that lead to other hidden passages, and chambers; of which there are many more to be brought to light. There are no 'doors' on hinges, nor padlocks, hasps or staples, to allow or prevent the entering to any part of the Great Pyramid. But, in time, it will be found, that there is a perfect system of inlets and outlets, through the apparently solid walls; by a system of pressure, which we have yet to discover. Still another *as great a mystery exists;* how did they light it? certainly not by torches or candles.

The Queen's Chamber, Now Open, Was Once So Concealed.

(Sec. 91.) There was once, at or just inside the northern end of the Grand Gallery, and in, or beneath, the rising floor thereof—a more extensive trap-door, which then concealed all access to the now so-called Queen's Chamber and the horizontal passage in these days leading so clearly to it. At present, when the traveller enters the north end of the grand gallery from the sloping difficulties of the first *ascending* passage, he is delighted to meet with a level floor; but following that southward, he finds that it guides presently, not to the further end of the grand gallery, but to a hole under a steep escarpment, only a few feet further on, formed by a cleft broken down of that gallery's true floor; in fact to the beginning of the low horizontal passage leading to the, in modern times, so-called Queen's Chamber. (See Plates IX., X., and XI.) The floor surface of the grand gallery itself is inclined upwards at the typical angle of 26° 18′; and did once run from the lowest north end, directly up, through 150 feet of distance, to the "great step" at the south, or upper, and further, termination of the gallery, in one continued slope. But now we are met, at the very beginning by a great hole, or absence of gallery floor. Yet there are traces still visible in the masonry on either side of that hole, well interpreted, first by Mr. Perring, and later by Mr. W. Dixon, both engineers; showing, that a neatly laid and joist-supported flooring, nine inches thick, did once exist all along over that hole, completing thereby the grand gallery's floor; and in that case entirely concealing and utterly shutting out all approach to, or knowledge touching the very existence of, the Queen's Chamber.

The Queen's Chamber seems to have given the principal Egyptologists, more than the average food for thought. Mr. Perring, for instance, imagined that it was used for a store room during the building of the Pyramid. To which others queried:—"and if so, to what end are all the following features; features, too, which are more certain than that use; for the features exist still, and can be seen every day; but who ever witnessed the alleged use?

(1.) The central axis of the niche in the east wall (and that niche is this Queen's Chamber's only architectural adornment, but a most noticably grand one) is strangely not in the central vertical line of that wall but is removed southward therefrom, by just one Pyramid cubit (= 25.025 English inches). See Plate XI.)

(2.) The height of the niche, multiplied by that grandly fundamental quantity in the Great Pyramid, *pi*, and that multiplied by the Pyramid number, 10 = the height of the Great Pyramid; or 185. x *pi* x 10 = 5812, in place of 5813 inches. This very close approach must, however, be accidental, for the height of the niche is uncertain, on account of the roughness of the floor, by 2 or 3 inches." One of the most curious points, however, regarding this chamber, is: its salt-encrusted stone, both from the floor and on one side.

(?) is there not another chamber adjoining, filled with salt? used to demonstrate the 'life-giving' qualities of this mineral substance?

(3.) The hieght of the niche, less the height of its inner species of long shelf, equals similarly the half of the base-side length of the Great Pyramid; or 185 (—39.6) x 10 *pi*= 4568, in place of 4566 inches. (The shelf's height is by the very rough measures, between 38 and 40 inches.)

(4.) The height of the north and south walls of the Queen's Chamber measured=15 feet 2.22 Pyramid inches =1 inch, and assumed 182.62 give—

(a.) $\frac{182.62 \times 100}{2}$ =9131=length of Great Pyramid's base side in Pyramid inches.

(b.) 182.62 x 2=365.24=solar days in solar tropical year.

(5.) The breadth of the Queen's Chamber measured= 205.6 assumed 205.0, gives—

182.62 : 205 :: 205 : 230.1=height of King's Chamber from floor to ceiling: *i. e.*, the first height there.

(6.) The square root of 10 times the height of the north or south wall, divided by the hieght of the niche=*pi;* or,

$$pi = \sqrt{\frac{182.62 \times 10}{185}}$$

All of the above theorems, save the first, are the discoveries of Professor Hamilton L. Smith (of Hobart College, Geneva, New York), who, without having been to Egypt, has, by successfully interpreting the principal authorities on the Great Pyramid, constituted himself in a most unexceptional manner the chief authority on the Queen's Chamber. 'Either,' said he, "there is proof in that chamber of supernatural inspiration granted to the architect; or—that primeval official possessed, without inspiration, in an age of absolute scientific ignorance, 4,000 years ago, scientific knowledge equal to, if not surpassing, that of the present highly developed state of science in the modern world."

Mr. W. Dixon, in 1872, discovered that the Queen's Chamber is supplied with two perfect ventilating channels in its north and south walls, nearly similar to those in the King's Chamber; although aparently they have never been put to use. Through the aid of a hired man with a hammer and chisel, Mr. Dixon has a hole driven into each of those ventilating channels; and *in each*, the said hired man lost (by accident) a steel chisel, in endeavoring by over zealous force, to break into the said channels. *Some day* those chisels *will be found*, and then the cry will go forth, "oh! the Pyramid is only a modern structure; I told you so."

THE QUEEN'S CHAMBER'S AIR CHANNELS —*Unexplained Feature.*

When the inner ends, or ports, were proved to have been separated from the air of said chamber merely by a thin plate of soft limestone (so easily pierced by the laborer's chisel), that the general impression was, that they had originally been in use, but had been stopped by some mediæval traveller with a small stone patch. But this was not the case; for Dr. Grant and Mr. Dixon successfully proved that there was no jointing, and that the thin plate was a 'left,' and a very skillfully and symmetrically left, part of the grand block composing that portion of the wall on either side. That block, had had the air channel tube (9 x 8) inches sculptured into it (from the outside direction as of the whole building), neatly and beautifully so far as it went; but that distance was not quite through the whole block and into the room, by the typical quantity in the Great Pyramid of five inches. The whole air channel then, save that little unopened bit, was in place; but could never have been used. Not, too, that it had been tried, found inconvenient, and was then stopped up by the original builders; for they would in that case, according to their usual style of masonry, either have filled the port with a long plug, or would have replaced the whole block carrying the inner end of the channel, with another solid block

The whole air channel, however, is in place, but just how far the channels courses are carried through the 300 feet of masonry which separate this chamber from the outer air, is not yet known, but believed to have had an outer entrance.

ENTRANCE INTO THE GREAT PYRAMID.

(Sec. 92.) What sort of entrance had the Great Pyramid originally? The front and chief gate, or door, of almost every other species of public building, from temples to churches, and castles to palaces, is usually the most elaborated and ornamental part of the whole structure to which it belongs; but, excepting only the obscure mention of a movable stone in Strabo's time, by which a man might just creep into the descending entrance passage—it is believed there was nothing to mark any entering-in place at all at the Great Pyramid; but that the smooth, planed-down surface of the casing-stones covered, and concealed, all that region; and in fact did most effectually hide the essential point from any one who approached without traditional information to guide him.

Nothing of what we see *now* connected with the internal masonry and constructive arrangements, ever projected through the casing stone film; and the very fact of Caliph Al Mamoun making his excavation in a different place, may be taken as a proof that nothing ever did, in any conspicuous manner, externally mark the spot.

Then why did the builders commemorate the one and only (*apparently*) outside entrance, not on the exterior, but in the *interior* masonry; and so grandly, with four inclined stones, which we can now see?

The above and similar questions have been kept before the public, from 820 A. D., down to the present date.

But, what sort of entrance had the Great Pyramid originally? We will try to present a "key to the Mystery." In the first place, we can see no reason why there should be any exception to the generally accepted conditions, for a *large* and "elaborate entrance" to the Great Pyramid, than for any other prominent building in the world; in this, or during any other age. Acknowledging as we do, that the builders of the Great Pyramid were far wiser than the wisest of our present civilization, then what? *Why*, they *did* leave a *very elaborate*, and appropriate entrance to that building. What kind of an entrance would be appropriate for a structure of that magnitude, irrespective of its character?

Let us draw a pen picture of its size: The Great Pyramid when it stood perfectly enveloped with all its angle stones in place, in and previous to the year 820 A. D.; covered an area of about 13⅜ (English measurement) acres; it stood in perfect pyramidal shape, with its apex 486 feet above the pavement on which it stands; and weighed 5,273,834 (Pyramid) tons.

Such a large mass of material as that, could not (*consistantly*) be represented by an entrance, so insignificant as the present (supposed) entrance on the north side of the building represents; with an opening of only 47 by 42 inches. But, you will say; that is the only entrance visible, or that can be found. Let us see: imagine yourself standing on the top of the Great Pyramid in its present dilapidated condition, near the center of the structure, then cast your eyes away in a southeast direction; and at a point 5,380 feet from where you stand, or about ⅞ of a mile from the S. E. corner of the Pyramid, you will discover the (very much abused 'Sphinx,' looking away from you in the same direction. This inaminate stone being is the Guardian, (or Tyler) of this greatest of all structures, the Great Pyramid. The entrance to which, we firmly believe, will be found to be, beneath the body of this oldest and most remarkable statute in the world today. Which, if it could speak—would say:—"Knock, and you may enter here."

The distance we have given above, of the location of the "Sphinx" away from the S. E. corner of the Pyramid, is found to be just *five* times the distance of the 'diagonal socket length' of the Great Pyramid, from the center of the Subterranean Chamber, under the Pyramid, to the supposed entrance under the Sphinx.

We quote from the 'American Cyclopædia,' a little modern history of the Sphinx, *viz.*—"The great Sphinx at the pyramids was supposed by Lepsius to represent King Cephren, the builder of the second pyramid; but an inscription has lately been discovered which renders it probable that it was sculptured even before the time of Cheops, the builder of the first pyramid. The Egyptians called it Hor-em-khu, or Har-ma-khu, the 'setting sun,' the name of the god to whom it was dedicated, which was converted by the Greeks into Armachis. It is near the eastern edge of the platform on which the pyramid stands, with its head turned toward the Nile. The head measures 28 feet 6 inches, from the top to the chin. The total length of the body, which is that of a lion crouching close to the ground, is 146 feet. Across the shoulders it measures 36 feet, and the paws are extended about 50 feet. Between the paws was built a small temple, which was of masonry, as were the paws, while all the rest of the Sphinx seems to be carved out of solid rock. Col. Vyse drilled a hole 27 feet deep into one of the shoulders, and found that it was one piece of stone throughout. Near the sphinx Mariette discovered a vast temple buried in the sand, which is supposed to have been dedicated to the worship of the divinity of the sphinx. The countance is now so much mulitated that the outline of the features can with difficulty be traced. The head has been covered with a cap, the lower part of which remains, and it had originally a beard, the fragments of which were found below. Immediately under the breast stood a granite tablet, and another of limestone on either side resting against the paws. The first contains a representation of Thotmes IV. offering inscense and making libation to the sphinx, with a long inscription in hieroglyphics reciting the titles of the king. On the paws are inscriptions of the Roman times, expressive of adoration to the sphinx or to the Egyptian deities."

FURTHER FROM THE CRITICS OF THE "GREAT SPHINX."

(Sec. 93.) Nearly every Egyptologist, and writer upon the subjects of antiquity and Egyptology have *studiously* avoided giving any deatils regarding the Great Sphinx. When they have, it has usually been couched in a language of abuse for its designors, and sculptors; designating them—as idolators and pagans. Apparantly avoiding the subject as though it were dangerous. Let us quote from Prof. Smyth:—

"But the reign of the Great Sphinx over the souls of some men, is not over yet.

"Long since I had remarked that there is no agreement possible between the Great Sphinx and the Great Pyramid. Those who admire the one cannot appreciate, and rather war against, the other.

"So it was given lately to a pure Egyptologist, quite anti-Pyramidal in sentiment—the eminent Mariette Bey, to set the whole of his world alight (for a time) with a supposed monumental proof that the Sphinx, instead of belonging, as hitherto so generally supposed, to the 11th or 15th dynasty, was far older than the Great Pyramid in the 4th dynasty; and was, in fact, so ancient, that it had become an object of dilapidated, but revered, antiquity in the time of King Cheops himself; who immortalized his name, in his very primeval day, by repairing it." Again, Mariette Bey states in his fourth edition of his "Catalogue of the Museum of Egyptian Antiquities at Boulak:—

"A fragmentary stone which may be *supposed* to have formed once part of a wall of a certain building, or temple, some problematical ruins only of which have been found near one of the small Pyramids on the east side of the Great Pyramid."

"The stone is abundantly inscribed with little hieroglyphics; in good preservation, but of *mediocre style*."

Dr. Grant, of Cairo, said to a friend, that the hieroglyphics on the Sphinx, were '*more like scratches than any-*

thing else.' And adds further that 'Mariette's Sphinx temple stone *bears a lie on the face of it*—that the style of sculpture is not very ancient, and that the whole inscription is simply a legend that has been scratched upon it at a late date, and that it cannot be quoted as an authority on any of the points mentioned in it.' "

That is just what we should have expected to have found. As we *firmly believe* that every *scratch* or *hieroglyphic* carved upon the Great Sphinx, or upon any thing adjoining or in close proximity to it have all been done by others than the original sculptors, thousands of years after the original was placed in position.

The builders of the Great Pyramid (and that includes the Sphinx) placed no names, numbers, or hieroglyphics, upon their work; but by the looks, and mathematical proportions, the intelligence of their followers *knew* what each design meant. Every chamber, passage-way, and layer of stone, had its meaning. So, that at each step taken by a candidate for higher honors, the unwritten lesson appealed to his intelligence, but, was whispered in his ear. In comparison with which a "French 1st degree in Masonry was *boys' play*.

Let me paint a little pen picture of the Great Sphinx, appealing to all intelligent 'travelers' who are unable, or cannot visit the Great Pyramid and Sphinx:—imagine a perfectly sculptured image of a "lion's" body 146 feet in length, with the *strong grip of his paws* extending fifty feet from his shoulders; the whole body covered by a proportionate sized *intelligent* human head. Then ask yourself if the greatest human intelligence, coupled with the greatest animal strength; appeals to your sense of *being raised from the grave* and an ignominous death, and asked to live on?

Then as a fitting climax to close this subject of the "Sphinx" we will ask—is this a suitable, proper, and sufficiently imposing "entrance" to a building 486 feet high, wieghing 5,273,834 tons, and covering $13\frac{3}{8}$ acres in area?

The Sphinx has at Least one Investigator.

For several years previous to 1896 A. D., Mr. Geo. E. Raum, a resident of San Francisco, Cal., has been delving under the *Great Sphinx* with the aid of a number of Egyptian natives. His friends say that he has issued a small book on the subject of the Sphinx, giving his discoveries. If so (?) we have been unable to trace it, or to have the pleasure of meeting Mr. Raum. A rumor exists, however, that he has discovered something regarding the Sphinx, that he desires to keep as a secret for the present. Be this as it may, we have written the above in self defense, that our friends will not charge *our theory* of the Sphinx to have been taken from any person or publication.—The Author.

The Vertical Axis, and the N. E. Corner of Great Pyramid—*Conclusions of Mr. C. Muir.*

(Sec. 94.) The length of the King's Chamber is now known to be 412.132 Pyramid inches. Subtract from that quantity half the already well-measured breadth of the doorway, *viz.*, 20.606 Pyramid inches, at the east end, to get the place of the central plane of the passages themselves; and then subtract from the other end 100dth of the Pyramid's base-side, or 91.310, and we have left 300.216 Pyramid inches, displacement of the passage plane, east of the meridian plane of the whole Great Pyramid; and the horizontal distance from the north-east corner of the coffer to the central vertical axis of the Pyramid, in meridian direction. That is not at present to be tested accurately but it cannot be far from the truth; and it places the north-east corner of the coffer in a very remarkable position vertically over the Great Pyramid's base, it reminds also that the *northeast corner socket* of the four corner sockets of the base, is the largest of the whole of those sockets; and that, of the northeastern socket's own corner's, its *north-east* one is the most accurately finished; and is *the* one which defines the ancient position of the northeast angle of the whole basal plane.

What then shall we make of the 300.216 Pyramid inches quantity obtained in this manner? The first use is to multiply it by 10, as with the cubic diagonal of the King's Chamber, to translate it into whole Pyramid proportions; and then to use it as the sine for its actually overlying radial quantity, the inclined height of the Great Pyramid, otherwise determined = 7391.55 Pyramid inches; when it yields the angle = 23° 57′ 50″. Which is within 49 seconds of arc of what the obliquity of the ecliptic was in 2170 B. C."

Cubic Contents In Pyramid Inches.

(Sec. 95.) Of the Queen's Chamber = 10,000,000; or 69,444.44 cubic feet.

Of the King's Chamber = 20,000,000; or 138,888.88 cubit feet.

Of the Grand Gallery = 36,000,000; or 250,000 cubit feet.

The Grand Gallery has exactly 36 roof stones = 1,000,000 cubic inches capacity, for each roof stone.

The Grand Gallery's Ramps and Ramp Holes.

The ramps, or inclined stone benches, that extend along the entire length of the Grand Gallery number 28 on each side; if you count one on each end of the great step. Of these 28, on either side 25, *viz.*, all except the lowest two and upper one, are distinguished by a piece of stone something like 13 Pyramid inches broad and 18 high, but with considerable variations,being let into the wall vertically and immediately over them; while of those 25, no less than 24 (on either side) are crossed slantingly, not by another let-in stone, says Dr. Grant, but by a broad, transverse, shallow groove, measuring more or less about 22 inches long 12 broad, and 1 deep; with its lower edge about three inches above the ramp's surface.

Our aim in placing this volume before the general public at this time is; that every important point existing in the Great Pyramid, or regarding the Great Sphinx, that has really been discovered, and *positively known* to exist at this date; shall find a place somewhere in these pages. And, not be dependent upon a score of 'other references.' The *purely theoretical*, 'of others,' will only be used, for comment in self defense.

At a point about 180 feet, 10 inches, (or 2170 inches, as Professor Smyth puts it), from the entrance of the north passageway (or present way of entering the Great Pyramid) there exists a double joint; with a line ruled across, or cut into the stone, that has created considerable comment, from the time it was first given publicity in 1865, down to this date. It is located at a place where two adjacent wall-joints, similarly too, on either side of the passage, and almost *vertical;* while every other wall-joint above and below it, are *rectangular* to the length of the passage, and therefore largely *inclined* to the vertical. It has been speculated on by various persons as possibly pointing to some still undiscovered chamber; and it may do so, just as the diagonal joints in the floor at a lower level are now clearly seen to point, to the upper ascending passage, and all that it leads to. This mark was a line, nothing more, ruled on the stone, from top to bottom of the passage wall, at right angles to its floor. Such a line might be ruled with a blunt steel instrument, but by a master hand for power, evenness, straightness and still more eminently for rectangularity to the passage axis. Every engineer that has placed his square upon this line, in modern times, that supposed it was out of true, on reversing his instrument—was led to remark, "I cannot positively accuse the ancient line on the stone of *anything* wrong." There is one such line on either wall, the west and the east, of the passage; and the two lines seem to pretty accurately opposite to each other; nor is any such agreement required for mere mechanical considerations in the masonry simply as such; for that is rather in favor of the joints on one wall 'breaking joint' with those on the other. This is the point, where Professor Smyth, gets *his* date of the building of the Great Pyramid, *viz.*, in 2170 B. C., as it is located just that many Pyramid inches from the beginning of the angle passage on the north side of the building. *We think*, that it simply shows the *anniversary* of '*a* Draconis' being central in that passageway, at that time, if it means anything regarding a date.

DISCOVERY OF THE ROSETTA STONE.

(Sec. 96.) The discovery of the "Rosetta Stone" by Young and Champollion, occurred in 1802; this 'trilingual,' or, as it is known, "Rosetta Stone," takes its name from the village of the same name, located some 36 miles E. N. E. of Alexandria, on the westerly or Rosetta branch of the Nile; and about 6 miles from the Mideterranean, by way of the river. The vivifying of this noted 'relic' by Professors Young and Champollion, in 1820, was followed and most ably developed, by Professors Birch, Brugsch, Chabas, De Rouge, De Saulcy, Lepsius, Mariette, Osburn, Poole, Rossellini, and many others. The interpretation of which, makes it rank among the most extraordinary discoveries of the last century. Of which, more later.

CHRONOLOGY OF THE EGYPTOLOGISTS.

(Sec. 97.) The leading principal, of the best Egyptological chronologists is to seek out and confide in *monuments;* to consider nothing fixed in Egyptian history or fact unless there is a monument for it it to show, and that monument contemporary, or nearly so, with the facts which it relates—they allow faithfully that they know of no monuments whatever at all earlier; Dr. Lepsius is very clear on this point. In his "Letters from Egypt," he wrote from his encampment amongst the tombs in the neighborhood of the Great Pyramid in 1843;—"Nor have I yet found a single cartouche that can be safely assigned to a period previous to the fourth dynasty. The builders of the Great Pyramid, seem to assert their right to form the commencement of monumental history."

To make an exhibit of how *little* any of the Egyptological scholars *know* regarding back dates; especially regarding the first fifteen Dynasties of Egypt: Let us quote:—The date of the first dynasty is placed in the year 5735 B. C. by Lesueur, Mariette, Renan, etc., and in 3892 B. C., by Lepsius, Bunsen, Fergusson, etc.; and in 2700 B. C., by Lane, Wilkinson, Rawlinson, etc.; and by William Osburn in 2429 B. C., a difference between the two extremes, of 3306 years. The difference is not a *very* great quantity; only about *one half* the present age of the earth, (as figured by biblical scholars); *but just think* of our depending upon these *eminent gentlemen* for *real* information. The extremes between the above named eminent gentlemen, in the 15th dynasty dates is only 201 years. But even *that* makes us turn grey at 21 and feel young at five score.

Architectural Facts of the Great Pyramid.

(Sec. 98.) From all the Egyptological writings, and from all the authors, whose works we have been privileged to investigate, and quote; those of Professor James Ferguson have been of the most satisfying character. Especially where *sound*, theoretical judgment was necessary; of the *detective* character. And, this class of judgment, is needed at every step in Egyptological research.

Speaking of the Great Pyramid professionally, and because professionally with him, learnedly, Mr. Ferguson allows it to be "the most perfect and gigantic specimen of masonry that the world has yet seen"; and that, according to mere human methods of development and all rationalistic theories of progression, almost infinite myraids of years must have intervened between the first rude tumuli, (or stone sepulchres) erected, or which he believes were, or should have been, erected in Egypt, and the building of *such* a Pyramid.

But in steps a dozen other Egyptologists, with the query: "In that case, there ought to be vastly more stone monuments scattered around Egypt, representing the work of man *before* the day of the Great Pyramid, than *after* it; especially as in the dry Egyptian climate, we are told again and again that *nothing decays*." In reply to this we repeat what we said in the early portion of this work: that, the builders of the Great Pyramid, obtained their experience (through thousands of generations) in another country, with a different climate, that now lies at the bottom of an ocean; now covered by over 500 feet of chalk; the formation and accumulation of thousands of years. And *some day*, it will again be a continent; and reveal to survivors of other parts of the earth, or the new created population; the wonders of the misty past.

Professor Ferguson, Dr. Lepsius, and many other Egyptologists announce: "that however multitudinous may be the Egyptian mounments *after* the Great Pyramid, there are *no* monuments at all in and throughout Egypt older than the Great Pyramid."

We claim, and the substantial theory of our reasoning is: that when the Great Pyramid was erected, on the banks of (what we now call) the Nile, that there were no inhabitants then living in the whole of Egypt. And, if there were, they represented the lowest class of intelligence of that age. This Pyramid was placed there, (as we have previously stated) because it was the center of all the land of the earth. And, would withstand a "cataclysm."

The Noachian Deluge of the Bible.

(Sec. 99.) Dates of, by prominent Divines, and Biblical scholars. *viz.*—A letter written 41 years ago, by the Archbishop of Canterbury, states: (1.) "The Church of England has assigned no date to the Noachian Deluge. (2.) the Church has not fixed any dates between which it must have taken place. (3.) The Church of England has not authorized the insertion into the authorized copy of the English Bible, of any system of dates."

Authorities.	*Date of Deluge, B. C.*
Septuagint, Alexandrine (Kitto's Palestine	= 3246
Jackson	= 3170
Hales	= 3155
R. Stewart Poole (Smith's Bible Dictionary)	= 3129
Samaritan (Kitto's Palestine)	= 2998
W. Osburn (Mónumental History of Egypt)	= 2500
Elliot's Horæ Apocalypticæ	= 2482
Browne's Ordo Sæclorum	= 2446
Playfair	= 2351
Usher	= 2348
Petavius (Smith's Bible Dictionary)	= 2327
Smyth, Mean of the whole	= 2741

Variation of the extremes—919 years.

Future of the Great Pyramid.

(Sec. 100.) Of all the Egyptologists and writers on the past, present, and future of the Great Pyramid, none have been so devoted, and persistent, in their efforts to establish a theory of their own, as Professor Piazzi Smyth. He has devoted hundreds of pages in his different issues regarding the 'Great Pyramid,' to substantiate his *theory* of the 'Divine origin' of this "First Great Wonder of the World." Hundreds of quotations from the prophesies of the Bible have been lined up by Professor Smyth to prove his measurements. The most noted point that we now desire to call attention to is, his measurement of the principal passageway, up to a point in the Grand Gallery; which distance, as measured is: 1881.4 Pyramid inches. The beginning of this passage way (to him) indicated the birth of Christ. The measurement '1881.4 inches' up that passage way appealed to him—that some *great religious* change would occur, about the year 1881, A. D., or before the (4th) fourth month of 1882. He did not think, (so he wrote) that it would bring us to the end of all things terrestrial; but something equal to the "Second Coming" would occur.

As the Professor passed to the beyond (peace to his ashes), just before the final months of that date, he was not present at the peaceful passing of that year; barring the usual 'earthquake reminders,' of the frailness of this orb which we still inhabit.

Professor Howard Vyse made the length of the Grand Gallery only 1872 inches; this (1872 A. D.) was his date for the phenomena. And, a Mr. Lane, had a date (1894), for extraordinary occurrences.

As all those dates have come and gone we must seek other conditions to satisfy our tape line and square.

THE SEVEN NATURAL WONDERS OF THE WORLD.

1. The Grand Canyon of the Colorado River.

(Sec. 101.) Nature has prepared the most wonderful combination of *chaos* and *harmony* for many miles along the Colorado river, that can be found in the known world. The *views* to behold from "Rowe's Point" and at, or near the site of the Santa Fe R. R. Co.'s new hotel, located some 59 miles north of Williams, on the main line, on the south side of the river, are simply *indescribable*. At the points above mentioned in viewing the north shore of the canyon, known to be some 400 feet greater elevation, than on the south side at the points mentioned; it is so deceptive, that you imagine with a good rifle you could kill a deer on the opposite bank from where you stand, yet you are told that the distance is *13 miles away;* and the stream itself over a mile beneath your feet. Wrapped in such an inextricable and bewildering labyrinth of matter and color, as to *deaden* your senses.

It is noted, that *all visitors* irrespective of character, on first viewing the scenes above mentioned, either remain *mute* for some minutes, or speak in subdued tones.

2. The Mammoth Cave of Kentucky.

The largest cavern known, is situated in Edmondson County, near Green river, and about 75 miles S. S. W.

of Louisville, Kentucky. The entrance to which is reached by passing down a wild, rocky ravine through a dense forest; it is an irregular, funnel-shaped opening, from 50 to 100 feet in diameter at the top, with steep walls about 50 feet high. The cave extends about nine miles, and it is said that to visit the portions already traversed requires from 150 to 200 miles of travel. This vast interior contains a succession of marvelous avenues, chambers, domes, abysses, grottoes, lakes, rivers, cataracts, etc., which for size and wonderful appearance are unsurpassed. One of its avenues (Stillman's) is about 1½ miles long, from 20 to 200 feet wide, and from 20 to 40 feet high. The "Temple or Chief City" in it, is a chamber having an area of about five acres, and covered by a single dome of solid rock 120 feet high. There are several bodies of water in the cave, the most considerable being Echo River, which is about ¾ of a mile long, 200 feet wide at some points, and from 10 to 30 feet deep; its course is beneath an arched ceiling of smooth rock about 15 feet high. This river has invisible communication with Green River, the depth of water and the direction of the current in the former being regulated by the stage of water in the latter. The river Styx, 450 feet long, from 15 to 40 feet wide, and 30 to 40 feet deep, is spanned by an interesting natural bridge about 30 feet above it. Two remarkable species of animal life are found in the cave, in the form of an eyeless fish and an eyeless crawfish, nearly white in color. Another species of fish has been found with eyes, but totally blind. The atmosphere of the cave is pure and healthful; the temperature is about 59° and the same in winter and summer.

3. Calaveras Grove of Big Trees.—(*Arba Vita.*)

This grove (which includes South Grove 3 miles distant) is located 14 miles north of Murphy's in Calaveras County, California; and contains about 275 trees (of *Arba Vita*) that are from 16 to 38 feet in diameter, and from 175 to 350 feet in height. One of the fallen 'Monarchs' of this grove, known as the "Father of the Forest," stood 450 feet in height, and 40 feet in diameter. Some 375 feet of this remarkable tree still remains. It is estimated that this tree was 4,500 years old when it fell; and as another tree known as the "Mother of the Forest," has grown up since, on the same spot where this tree was uprooted, that is estimated to be now over 2,500 old, the "Father of the Forest" (the *fallen monarch*) must have stood over 7,000 years ago.

Some 25 years ago the proprietors of the Calaveras Big Tree Grove, had the ground pieced near where the Father of the Forest lies; with the result that their auger ran into an *arba vita log in perfect* preservation at some 30 feet below the surface. How old must that log have been before the Father of the Forest was even a seed? And still they say the earth is only 5,900 years old.

4. Yosemite Valley.

.This noted valley, through which flows the Merced River, is located in Mariposa County, California; distant some 88 miles from Merced (on the S. P. Co.'s R. R.) and is now reached by the Y. V. R. R. *via* Merced to El Portal, (80 miles) thence by stage (12 miles) into the valley.

The valley proper is about 3½ miles long, and varies from ½ to 1¼ miles in width; with walls almost perpendicular (of natural rock) on either side of the valley, from ½ to 1 mile high. The climate is so mild, that (although the surrounding peaks are covered with snow and ice for six months in the year) the wild flowers are in bloom the year around, throughout the valley.

Its waterfalls; 'The Cascades,' 'Bridal Veil,' and 'Nevada Fall,' are noted for their beauty; but the 'Yosemite Fall' near the center of the valley, is probably the highest waterfall in the world. During the spring and early summer months, this fall has a clear descent of 2,600 feet.

But the *wonderful* features of this valley, consist of what can be seen pictured on the face of the rocks that surround it. *Viz.*—On the face of the rock, or peak, 'El Capitan,' can be seen the perfect figure of an 'Indian Chief,' in full dress, standing erect, looking down the valley. This figure is estimated to be over 80 feet in length, and is situated at least half a mile *vertically* above the valley. There are many other pictures of human beings on the adjacent rocks, but of lesser importance.

Also on the face of a peak in the upper end of the valley known as 'The South Dome,' if viewed about the hour of sunset, will reveal what would startle an astronomer: *viz.*—a perfect picture of the principal constellations of the northern heavens. Just after a visit to this valley during the year 1865, the Rev. T. Star King, was asked, if the above assertion was a fact? King replied: "Well, *yes*, but I would rather some one else would tell the story."

5. Niagara Falls.

Located in the Niagara River, connecting the great lakes of Erie and Ontario, between the State of New York and the Province of Ontario; although only 164 feet in height, and less than a mile wide, has the largest body of water passing over it of any single waterfall in the world besides being the most beautiful clean-cut waterfall known. The scene from the Suspension Bridge, below the falls in midwinter, when almost encased in ice is almost beyond description.

This fall *ran dry once* in the history of the U. S.; it occurred on March 31, 1848, caused by an ice jam in the river between Buffalo, N. Y., and the Canadian side; coincident with a strong east wind which drove the waters of Lake Erie to the west side. It lasted about a whole day. During which time a lady walked from "Table Rock" one third of the way across to Goat Island and returned in safety.

6. The Rocking Stone of Truckee, California.

Owned and Housed by Hon. C. F. McGlashan.

There are several rocking stones throughout the U. S. and Europe; but none of them so completely mystifies the observer, as the one located as above stated. This one is so isolated from the surrounding rocks, and the rocking stone itself so perfectly and delicately poised in the center of its perfectly level (on top) table stone, as to leave a doubt in the minds of most visitors, as to whether a freak of nature did the work, or, as some important personages claim, it was done by an extinct *race of giants* that flourished in the time of the 'giant Og,' who was 16 feet tall. (See Deuteronomy 3–11.)

The table (stone) upon which this particular rocking stone rests, is shaped (very) like the 'human heart' and stands on the small end, perfectly poised, some 30 feet high, with the strata or grain of the rock, running perpendicular. The top almost perfectly level, and some 25 feet in diameter. The Rocking Stone itself, shaped also like the 'human heart' (but more *perfect* than its table stone), is located almost exactly in the center of the one on which it stands, (also poised on its small end) and weighs about 16 tons; and yet it is so perfectly balanced that a child of five years can move it either way. The table stone upon which this Rocking Stone rests, *may contain* a considerable amount of '*radium*'; but whether it does or not, it is noted that snow (which lies all around it during the winter season, for weeks at a time) has never been known to remain upon this rock more than a few hours after any snow storm.

7. Ancient Animal and Human Footprints (or Tracks) on the Floor of the State Prison Yard at Carson, Nevada.

The tracks of a 'Mastoden' or 'mammoth elephant' showing a stride of between 6 and seven feet and a track nearly 2 feet in diameter; together with a trail of human (*moccasined feet*) foot prints that are over 18 inches in length, and well proportioned; and bird tracks that are larger than those of our ostrich, are some of the preserved curiosities to be seen, on the floor of the State Prison, at Carson, Nevada.

Over 40 feet in thickness of rock, limestone in character, apparently of original formation, was removed from over the tracks, when the prison was built. Geologists assert: that over 40,000 years elapsed during the formation of the rocks, that overlaid the footprints above mentioned.

The bones of one 'Baby Elephant' were found here; also a single piece of '*horn-blende granite*,' over 30 feet down in the limestone, large enough for a doorstep; they have preserved it.

EMPIRICISM—PHYSICAL SCIENCE—POSITIVISM.

Modern science accepts sensations, emotions, thoughts and volitions as the ultimate premises from which all our knowledge is derived. The spiritual and the supernatural it relegates to the domain of the unknowable, and takes no cognizance of them as facts. As mankind are divided into Aristotelians and Platonists, the modern scientist would call himself an Aristotelian minus metaphysics. Science proper as we know it to-day dates back to the 17th century—the age of Bacon and Harvey; but the greatest strides in its progress have been made since 1830. It was not till then that a philosophical classification of the sciences was attempted. Even to-day the method of arranging the sciences is a matter of serious debate. According to Comte (1840) the dependence and order of the sciences follow the dependence of the phenomena. The more particular and complex depend upon the simpler and more general. The latter are easier to study. Therefore science will begin with those attributes and objects which are most general, and pass on gradually to others that are combined in greater complexity. Each science rests on the truths of the sciences that precede it, while it adds to them the truths by which it is itself constituted. Comte's series or hierarchy of the sciences is, in its main divisions, as follows: **Mathematics,** *i. e.*, number, geometry, mechanics; **Astronomy, Physics, Chemistry, Biology, Sciology, Ethics.** Each member of the series is one degree more special than the science preceding it, and depends upon the facts of all the former members, and can not be fully understood without them. Herbert Spencer takes issue with Comte and denies that the principle of the development of the sciences is the principle of decreasing generality. He asserts that there are as many examples of the advent of a science being determined by increasing generality as by increasing specialty. He holds again that any grouping of the sciences in a succession gives a radically wrong idea of their genesis and interdependence; no true filiation exists; no science develops itself in isolation; no one of them is independent either logically or historically. Huxley agrees with Spencer; but still Comte has a large following all over the world. For the purpose of this work it will suffice to set down the greatest of the sciences in an order that will be intelligible and conform in some degree with their origin and development. Mathematics and mechanics are treated at some length in other parts of this work.

General Classification.—Mathematics, *pure*, arithmetic, algebra, geom try, trigonometry, calculus, *applied*, mechanics. **Astronomy, physics,** solids, fluids, gases, heat, light, sound, magnetism, etc. **Chemistry,** inorganic, organic, practical, pure. **Biology,** science of life, protoplasm, protein, germs, evolution, species, development. **Sociology,** social science, human society—yet in its infancy. Before there can be reached in sociology generalizations worthy of being called scientific, there must be definite accounts of the institutions and activities of societies, of various types and in various stages of evolution, so arranged as to furnish the means of ascertaining what social phenomena are habitually associated. Sociology will narrate how men became grouped in political communities, how they constituted authority and property, how they originated castes and guilds, and by degrees separated into high and low, rich and poor. To this comprehensive science many will be subservient, especially, **anthropology, ethnology, philology, history, archæology, politics, religion, literature,** and **political economy**. In all the main divisions there are numberless subdivisions, from elementary mathematics to ethics. The modern tendency is to specialize, and a lifetime now is not long enough for the mastery of one of the special sciences. Unfortunately, the moral sciences, or those dealing with man, are least developed, and have not yet been rescued by philosophy from empiricism. A disposition is, however, manifest now all over the world to employ in the moral sciences those methods which have heaped up such useful and undisputed truths in the physical sciences, especially in astronomy, physics, chemistry and physiology. Beyond sociology, a further step remains to be taken, viz., to morals. At this point theory and practice tend to coincide, because every element of conduct has to be considered in relation to the general good. In the final synthesis all the previous analyses will have to be used as instrumental—all the great laws which regulate the phenomena of the inorganic world, of organized beings, and of society, must be the material from which ethics, the coping-stone of the sciences, is to be wrought. Before there can be satisfactory human morals, based on rational altruism, every field of inquiry must be diligently explored in order that every real quality of things and men may be made to converge to the welfare of humanity. This is the creed of many a modern scientist.

TRANSCENDENTALISM, METAPHYSICAL PHILOSOPHY MYSTICISM.

The platonist, idealist, or speculative philosopher of the German school asserts that sensations, emotions, thoughts and volitions are not ultimate premises or fundamental truths, but only derivative and dependent for their validity on a spiritual, intangible, and universal reality or noumenon, the Pure Reason or Idea, of which all material phenomena, including sensations, etc., are only evidences. It is from this reality that mind and matter spring. There have been only two complete encyclopedic constructions in philosophy, viz., Aristotle's (323 B.C.) and Hegel's (1830). They embodied the philosophic aspects of all human experience in their respective epochs. Though the ancient Greek has not been wholly superseded by the modern German, it accords with the tenor of this work to presen t only a scheme of the Hegelian system. The *Great Introduction* opens with a review of man's experience, showing his mind, in respect to nature, under six aspects, viz.: mere consciousness, self-consciousness, reason, spirit, religion, philosophy. He can not rest till he has found absolute knowledge (*absolutes wissen*). He discovers that truth has three phases, dogmatism, skepticism, mysticism, or thesis, anithesis, synthesis. The universe is the self-evolution of the *idea*, or pure spirit, which first expands in nature, endued with mind, the product of both. The **logic**, which is at the same time a metaphysic, is an account, called transcendental dialectic, of the process in its infinite gradations, subdivided into three stages: (1) *Being*, becoming, and pure number and quantity by which *Being* is measured. (2) *Essence*, those correlative terms, law and phenomenon, cause and effect, substance and attribute, by which we explain the world. (3) *Notion*, the subjective terms, conception, judgment, syllogism, appearing in forms mechanical, chemical and teleological, leading to life and science as the complete interpretation of thought and objectivity, called the perfect *Idea*, with which begins the philosophy of **nature.** Here thought becomes perception, dialectic, gravitation, and causation, sequence in time. (1) *Mechanics*, space in time, matter, force. (2) *Physics*, the laws of heat, motion, sound, light, electricity, chemical affinity, and all material movements of change and interchange. (3) *Organic*, the completed work of these forces in space and time, ending in geology, botany and animal physiology. With the perfection of organized existence, begins the philosophy of **mind.** (1) *Subjecti e* deals with anthropology, or the natural soul, races, ages, dreams, insanity, phrenology, etc., and under phenomenology, with simple consciousness, self-consciousness, reason, spirit; under psychology, with theoretical and practical mind tracing the course of intelligence from the animal sensitivity of the Dryad up to the realization of spirit by mind. (2) *Objective*, including philosophical jurisprudence, morals, politics, and the philosophy of history. (3) *Wisdom* (*absolutes wissen*), the final grasp of the absolute in art, religion, and philosophy—the æsthetic, the philosophy of religion, and the history of philosophy. This wonderful construction of Hegel gave a great impetus to science by proving the sameness of many apparently different forces. He pointed out in the *logic* the path to be followed by philosophic inquirers, viz., a criticism of the terms of ordinary and scientific thought in their filiation and interdependence. The *logic* of Hegel is the only rival of the logic of Aristotle. What Aristotle did for the theory of demonstrative reasoning, Hegel attempted to do for the whole of human knowledge. Though Hegelianism has now ceased to exist as an issolated system, its spirit and method have leavened the whole mass of philosophic thought. French criticism of modern German metaphysicians declares that their vast constructions now hang in ruins, because with a high notion of human powers, they had none of human limitations. Abstraction is a German failing; cold fact, the English. Spencer, finding that sensible knowledge alone can be proved, declares that our own and all other existence is a mystery, absolutely and forever beyond our comprehension. Modern agnosticism and transcendentalism are antipodes of thought. Hegel's philosophy is so hard to understand that he once said, "Only one man has understood me, and even he has not." It has been eloquently said: "From all periods of history; from medieval piety and stoical pride; from Kant and Sophocles, science and art, religion and philosophy, Hegel gathered, in the vineyard of the human spirit, the grapes from which he crushed the wine of thought."

EXPLANATION OF CHARACTERS

Used in Calculating, Mathematics, Etc.

(Sec. 102).

$=$ *Equal to*, as 12 inches $=$ 1 foot, or 3 feet $=$ 1 yard.
$+$ *Plus* or *More*, signifies addition; as $7+9+8=24$.
$-$ *Minus* or *Less* signifies subtraction; as $21-7+10=24$.
$\times$ *Multiplied by*, or *into*, signifies multiplication; as $3\times8=24$.
$\div$ *Divided by*, signifies division; as $a\div b$; that is, a divided by b; $72\div3=24$.

☞ Division is also indicated thus: $\frac{a}{b}$; that is, a divided by b; $\frac{72}{3}=24$.

$:$ *Is to*; also, *To;* the ratio of; } —signifies proportion; as $3:6::12:24$; that is, as 3 is to 6, so is 12 to 24.
$::$ *As;* or *So is;* equals;

$\overline{}$ *Vinculum*, or *Bar*, signifies that the numbers, etc., over which it is placed, are to be taken together; $\overline{12-2}+14=24$, or $\overline{3+5}\times3=24$.

. *Decimal point* signifies, when prefixed to a number, that that number has some power of 10 for its denominator; as .1 is $\frac{1}{10}$, .12 is $\frac{12}{100}$, .123 is $\frac{123}{1000}$, .1234 is $\frac{1234}{10000}$, .12345 is $\frac{12345}{100000}$, etc.

$\sim$ *Difference* signifies, when placed between two quantities, that their difference is to be taken, it being unknown which is the greater.

$^{\circ}$ $'$ $''$ $'''$ signify *Degrees*, *Minutes*, *Seconds*, and *Thirds of Seconds*.

$\angle$ Signifies *Angle*. $\perp$ Signifies *Perpendicular*. $\triangle$ Signifies *Triangle*.

$\square$ Signifies *Square*, as $\square$ inches; and $\boxtimes$ *Cube*, as cubic inches. ▭ *Rectangle*.

$>$ *Is greater than* or ˥ *Is greater than;* as, $a>b$; that is, a is greater than b; $6>5$.
$<$ *Is less than*, or ˪ *Is less than;* as, $a<b$; that is, a is less than b; $5<6$.
$\not>$ *Is not greater than*; the contradictory of $>$; as, $a \not> b$; that is, a is not greater than b; may be equal to, or less than, but not greater.
$\not<$ *Is not less than;* the contradictory of $<$; as, $a \not< b$; that is, a is not less than b; may be equal to, or more than, but not less.

∞ *Indefinitely great; infinite; infinity;*—used to denote a quantity greater than any finite or assignable quantity. Δ *Finite difference.*

0 *Indefinitely small; infinitesimal;*—used to denote a quantity less than any assignable quantity; also, naught; nothing; zero.

$\therefore$ signifies *Therefore or Hence*; $\because$ signifies *Because*.

( ) [ ] *Parenthesis* and *Brackets*, signify that all the figures, etc., within them are to be operated upon as if they were only one; thus, $(6+2)\times3=24$; $[8-2]\times4=24$.

$\parallel$ *Parallel;* is parallel to; as, AB $\parallel$ CD.

p or π is used to express the ratio of the circumference of a circle to its diameter$=3.1416$

O *Circle;* circumference; 360°. ⌒ *Arc of a circle*; arc. a' a'' a''' signify a *prime*, a *second*, a *third*, etc.

$\pm$ $\mp$ signify that the formula is to be adapted to two distinct cases.

$\sqrt{}$. or $\sqrt{}$ *Root or radical sign*; indicating when used without a figure placed above it, the square root; as, $\sqrt{4}=2$; $\sqrt{4a^2}=2a$. To denote any other than the square root, a figure, (called the index) expressing the degree of the required root, is placed above the sign; as, $\sqrt[3]{a}$, $\sqrt[5]{a}$, $\sqrt[13]{a}$, &c.; that is, the cube root, the fifth root, the thirteenth root, &c., of a. ☞ The root of a quantity is also denoted by a fractional index at the right-hand side of the quantity and above it, the denominator of the index expressing the degree of the root; as, $a^{\frac{1}{2}}$, $a^{\frac{1}{3}}$, $a^{\frac{1}{6}}$; that is, the square, cube, and sixth roots of a, respectively; or, as 4^3 is$=4\times4\times4=64$.

g is the common expression for gravity$=32.166$; $2g=64.33$; $\sqrt{2g}=8.02$ feet.

⊠ signifies *Dead Flat*, or the location of the frame of a vessel at its greatest transverse section. $'$ $''$ set *superior* to a figure or figures, signify *feet* and *inches*.

℞ (Lat. *Recipe.*) Take; āā, of each; ℔, pound; ℥, Ounce; ʒ, Drachm;

℈ Scruple; ♏, Minim, or drop; O or o, Pint; f ℥, fluid Ounce; f ʒ, fluid Drachm; as, ℥ss, half an ounce; ℥i, one ounce; ℥iss, one ounce and a half; ℥ij, two ounces; etc., etc.

* Asterisk; † Dagger; ‡ Double Dagger; § Section; ‖ Parallels; ¶ **Paragraph**; ☞ Index; and ⁂ or ⁂ Asterism, are used in printing and writing as a reference to a passage or note in the margin, and take precedence in the order arranged above, when one or more than one are used.

DAY OF THE WEEK OF ANY GIVEN DATE,

For Sixty Centuries.

RATIOS FOR CENTURIES.

4	2	0	5	4	2	0	5	4	2	0	5
*	100	200	300	2000	2100	2200	2300	4000	4100	4200	4300
400	500	600	700	2400	2500	2600	2700	4400	4500	4600	4700
800	900	1000	1100	2800	2900	3000	3100	4800	4900	5000	5100
1200	1300	1400	1500	3200	3300	3400	3500	5200	5300	5400	5500
1600	1700	1800	1900	3600	3700	3800	3900	5600	5700	5800	5900

*The years 1 to 99, inclusive.

RATIOS OF MONTHS.

January....... ....**3**	April....... ....**2**	September...............**1**
" Leap Year........**2**	May.....................**4**	October **3**
February **6**	June................ ...**0**	November...............**6**
" Leap Year........**5**	July...... ....**2**	December................**1**
March............... ....**6**	August..................**5**	

RULE.—Of the figures denoting the year, strike off those occupying the place of units and tens; to this number add its one-fourth part, (disregarding the remainder, if any) the day of the month, the ratio for the century and the ratio for the month. Divide the sum by 7, and the *remainder* will denote the day of the week.

If the remainder be 1 the day denoted is Sunday.
" " " 2 " " Monday.
" " " 3 " " Tuesday.
" " " 4 " " Wednesday.
" " " 5 " " Thursday.
" " " 6 " " Friday.
If there be no remainder " " Saturday.

EXAMPLE 1.—Upon what day of the week did Columbus discover America?

Solution.—Date........October 12, 14 | 92
One-fourth of 92........ 23
Day of month.......... 12
Ratio for century 1400.. 0
Ratio for month of Oct.. 3
Ratio for Old Style Date 2
Divide by... ....7) 132
18—6 remainder, denoting that the day of the week was Friday.

EXAMPLE 2—Upon what day of the week was George Washington born?

Solution.—Date.......February 22, 17 | 32
One-fourth of 32........ 8
Day of the month...... 22
Ratio for century 1700.. 2
Ratio for month of Feb. 5
Divide by.............. 7) 69
9—6 remainder, denoting that the day of the week was Friday.

THE OLD AND NEW STYLE.

A year is the time required for the revolution of the earth around the sun, viz.: 365 days, 5 hours, 48 minutes, and 49 7-10 seconds. To include the fraction of a day Julius Cæsar decreed that every fourth year should consist of 366 days. This is the Julian, or Old Style, and is an excess for each year of 11 minutes, and 10 3-10 seconds, so that in 1582 there had been an over-reckoning of ten days. To correct this the 5th of October of that year was reckoned the 15th. Still there was an overplus amounting in a century to 18 hours, 37 minutes and 10 seconds so it was agreed that every centurial year that was not divisable by 400 should not be a leap year. This is the Gregorian or New Style, and was adopted by an act of the British Parliament, September 3, 1752. The difference between the New and Old Style is *twelve* days. The dates of some of the events previous to that year of that century (the date of Washington's birth, for example) were changed to accord with the New Style. In using the above rule regarding dates of events previous to 1752, care must be used as to what style they belong.

MATHEMATICS.

DEFINITIONS.

Fraction is one or more parts of a unit.

Decimal is a fraction, having for its denominator a unit with as many ciphers annexed as the numerator has places. It is usually expressed by writing the numerator only with a point at the left of it.

Rule of Three applies to cases in which three terms or numbers are given to ascertain a fourth and is direct or inverse.

Compound Proportion—resolves into one statement questions which require several statings in rule of three

Involution is multiplying any number into itself a certain number of times, the products are called powers, and the number is called the root or first power.

Evolution is finding root of any number.

Properties of Numbers.—If the sum of the digits constituting any number is divisible by 3 or 9, the whole is divisible by them. A square number cannot end with an odd number of ciphers. No square number can end with two equal digits except two ciphers or two fours. No number, the last digit of which is 2, 3, 7 or 8, is a square number.

Position is single or double and determined by the number of suppositions.

Fellowship is a method of ascertaining gains or losses of individuals engaged in joint operations.

Permutation determines in how many different ways any number of things may be varied in their position.

Arithmetical Progression is a series of numbers increasing or decreasing by a constant number or difference.

Geometrical Progression is any series of numbers continually increasing by a constant multiplier or decreasing by a constant divisor.

Alligation discovers the mean rate or quality of materials when mixed together.

Discount or Rebate is a deduction from money paid before it is due.

Perpetuities are annuities that continue forever.

Unit of Circular Measure is an angle which is subtended at center of a circle by an arc equal to radius of that circle. Circular measure of an angle is equal to a fraction which has for its numerator the arc subtended by that angle at center of any circle, and for its denominator the radius of that circle.

Probability that an event will occur is the ratio of the favorable cases to all the cases which are similarly circumstanced in reference to that event. The probabilities of two or more single events being known, the probability of their occurring in succession may be determined by multiplying together the probabilities of their events, considered singly.

Reciprocal of a number is the quotient arising from the division of 1 by the number. The product of a number and its reciprocal is always equal to 1. The reciprocal of a vulgar fraction is the denominator divided by the numerator.

Logarithms facilitate numerical computation and the logarithm of a number is the exponent of a power to which 10 must be raised to give that number. Addition is substituted for multiplication, substraction for division, multiplication for involution, and division for evolution.

Cone is made by the revolution of a right-angled triangle about one of its legs.

Conic Sections are made by planes cutting a cone.

Ellipse is made by an oblique plane cutting a cone above its base.

Parabola is made by a plane cutting a cone parallel to its side.

Hyperbola is made by a plane cutting a cone at any angle with base greater than that of the side of the cone. The *perimeter* of a figure is the sum of all its sides. A *problem* is something proposed to be done. A *postulate* is something supposed or assumed. A *theorem* is something proposed to be demonstrated. A *lemma* is something premised, to render what follows more easy. A *corollary* follows from a preceding demonstration. A *scholium* is a remark upon something which precedes it.

Table of Geometrical Progression.

Whereby any Questions of Geometrical Progression and of Double Ratio may be solved by Inspection, the Number of Terms not Exceeding 56.

1	1	15	16384	29	268435456	43	4398046511104
2	2	16	32768	30	536870912	44	8796093022208
3	4	17	65536	31	1073741824	45	17592186044416
4	8	18	131072	32	2147483648	46	35184372088832
5	16	19	262144	33	4294967296	47	70368744177664
6	32	20	524288	34	8589934592	48	140737488355328
7	64	21	1048576	35	17179869184	49	281474976710656
8	128	22	2097152	36	34359738368	50	562949953421312
9	256	23	4194304	37	68719476736	51	1125899906842624
10	512	24	8388608	38	137438953472	52	2251799813685248
11	1024	25	16777216	39	274877906944	53	4503599627370496
12	2048	26	33554432	40	549755813888	54	9007199254740992
13	4096	27	67108864	41	1099511627776	55	18014398509481984
14	8192	28	134217728	42	2199023255552	56	36028797018963968

ILLUSTRATIONS—The 13th power of 2=8192, and the 8th root of 256=2.

GEOMETRICAL DEFINITIONS.

CURVIFORM FIGURES.

A **CIRCLE** is a plain figure bounded by a regular curved line, every part of which is equally distant from a point within it called the *center*.

The CIRCUMFERENCE of a circle is the curved line by which the circle is bounded.

The DIAMETER of a circle is a straight line terminating in the circumference and passing through the center; or, the longest straight line that can be drawn within a circle.

The RADIUS of a circle is a straight line extending from its center to any point in its circumference; or, the semi-diameter of a circle.

An ARC is a portion of a circumference.

A CHORD is a straight line uniting the extremities of an arc of a circle, but does not pass through the center.

A SEGMENT is that part of a circle included within a chord and an arc; or, that part of a circle cut off by a chord.

A SECTOR is that part of a circle bounded by two radii and the included arc.

A SEMI-CIRCLE is half of a circle.

A QUADRANT is one quarter of a circle.

A PERIPHERY is the circumference of a circle, ellipse or other curvilinear figure.

An ELLIPSE is a figure bounded by an oval curved line having one long and one short diameter at right angles to one another.

A CYCLOID is a curve generated by a point in the plane of a circle when the circle is rolled along a straight line, keeping always in the same plane. A *common cycloid* is the curve described when the generating point is on the circumference of the generating circle; the *curtate cycloid* when that point is without the circumference; the *prolate* or *inflected cycloid* when the generating point lies within the circumference.

A PARABOLA is formed by the intersection of the surface of a cone with a plane parallel to one of its sides.

ANGLES.

An ANGLE is the opening of two lines that meet at one point, or that would meet if sufficiently extended. The point of meeting is called the *vertex* of the angle.

The number of degrees of a circle contained in the arc of a sector is the measure of the angle formed by the two radii.

A RIGHT ANGLE is one formed by a line joining another perpendicularly; or, at an angle of 90° marked by a quarter circle.

An ACUTE ANGLE is less than a right angle; or, less than 90°.

An OBTUSE ANGLE is more than a right angle; or, more than 90°

TRIANGLES.

A TRIANGLE or TRIGON is a figure of three sides.

An EQUILATERAL TRIANGLE has all of its sides equal.

An ISOSCELES TRIANGLE has only two of its sides equal.

A SCALENE TRIANGLE has all of its sides unequal.

A RIGHT-ANGLED TRIANGLE has one right angle.

An ACUTE-ANGLED TRIANGLE has all of its angles acute.

An OBTUSE-ANGLED TRIANGLE has one obtuse angle.

Quadrangles.

A Quadrangle is a figure of four sides.

A Parallelogram has its opposite sides parallel, and its opposite angles equal.

A Square or Tetragon has its four sides equal and four right angles.

A Rectangle has its opposite sides equal and four right angles.

A Rhombus has four equal sides and its opposite angles equal, two of the angles being acute and two obtuse.

A Rhomboid is the same as a parallelogram.

A Trapezoid has only two opposite sides parallel.

A Trapezium has no two sides parallel or equal.

Polygons.

A Polygon is a plane and right lined figure.

A Regular Polygon has its sides equal.

An Irregular Polygon has its sides unequal.

Solids.

A Cube or Hexahedron is a solid with six equal faces.

A Sphere is a solid, every part of whose surface is equally distant from a point within called a *center*.

A Spheroid is a sphere flattened or depressed at two opposite sides; an *oblate spheroid* is a sphere flattened or depressed at the poles; a *prolate spheroid* is a sphere extended, or elongated at the poles.

A Paraboloid is a solid described by the revolution of a parabola about its axis.

A Cylinder is a solid described by the revolution of a rectangle about one of its sides.

A Cone is a solid described by the revolution of a right-angled triangle about one of its sides.

A Pyramid is a solid the base of which is any kind of a polygon, and its other faces triangles uniting at a common point called a *vertex*.

A Frustum of a cone or pyramid is the part which remains after the top is cut off by a plane parallel to the base.

An Ungula is the part of a cone or cylinder which remains after the top is cut off by a plane oblique to the base.

A Parallelopiped is bounded with six parallelograms.

A Prism is a solid whose ends, called bases, are equal polygons, and whose sides or faces are parallelograms.

A Prismoid is a prism cut obliquely at the ends.

A Perimeter is the sum of all the sides of a figure plane or solid

Polyhedrons.

A Polyhedron is a solid contained by many faces or planes.

A Regular Polyhedron is a solid its faces or planes being equal.

An Irregular Polyhedron is a solid its faces or planes being unequal.

Units of Measure.

The unit of measure for lines is a linear unit.

The unit of measure for area or surface is a square unit.

The unit of measure for solidity or contents is a cubic unit.

All similar lines are to each other as their like dimensions.

All similar areas or surfaces are to each other as the squares of their like dimensions.

All similar solids are to each other as the cubes of their like dimensions.

PROPOSITIONS AND FORMULAS.

1. The diameter (d) of a circle being given, required the circumference (c):

$d \times 3.1416 = c.$

2. The circumference (c) of a circle being given, required the diameter (d):

$c. \div 3.1416 = d.$

3. The diameter (d) of a circle being given, required the area (a):

$d^2 \times .7854 = a.$

4. The diameter (d) and circumference (c) of a circle being given, required the area (a):

$d \times c \div 4 = a.$

5. The number of degrees (a) contained in an arc, and the diameter (d) of the circle being given, required the length (c) of the arc:

$a \times d \times 3.1416 \div 360 = c.$

6. The chord (a) of an arc and the chord (b) of one-half the arc being given, required the length (c) of the arc:

$b \times 8 - a \div 3 = c.$

7. The base (a) and height (c) of a segment of a circle being given, required the diameter (d):

$(a \div 2)^2 \div 3 + c = d.$

8. The number of degrees (c) in the arc of a sector and the diameter (d) of the circle being given, required the area (a) of the sector:

$c \times 3.1416 \div 360 \times d \div 2 \times \frac{1}{2} d = a.$

9. The greater (c) and less (d) diameters of a circular ring being given, required the area (a):

$c^2 - d^2 \times .7854 = a.$

10. The greater (c) and less (d) diameters of a ellipse being given, required the area (a):

$c \times d \times .7854 = a.$

11. The diameter (d) of the generating circle of a common cycloid being given, required the length (a) of the cycloid:

$d \times 4 = a.$

12. The diameter (d) of tne generating circle of a common cycloid being given, required the area (a) of the cycloid:

$d^2 \times .7854 \times 3 = a.$

13. The base (b) and parameter (c) of a common parabola being given, required the altitude (a):

$(b \div 2)^2 \div (c \times 2) = a.$

14. The base (b) and altitude (a) of a common parabola being given, required the area (c):

$b \times a \times 2 \div 3 = c.$

15. The base (b) and perpendicular (c) of a triangle being given, required th' area (a):

$b \times c \div 2 = a.$

16. The base (a) and perpendicular (b) of a right angled triangle being given, required the hypotenuse (c):

$\sqrt{a^2 + b^2} = c.$

17. The hypotenuse (c) and one of the sides (b) of a right-angled triangle being given, required the other side (a):

$\sqrt{c^2 - b^2} = a.$

18. The longer (a) and short (b) parallel sides of a trapezoid and the distance (c) between them being given, required the area (d):

$a + b \times c \div 2 = d.$

19. The diameter (d) or circumference (c) of a circle being given, required the side (a) of an inscribed square:

$d \times .7071 = a$ or $c \times .2251 = a.$

20. The diameter (d) or circumference (c) of a circle being given, required the side (a) of a square of equal area:

$d \times .8862 = a$ or $c \times .282 =$

TABLE OF REGULAR POLYGONS WHOSE SIDES ARE ONE.

NAME.	No. Sides.	AREA (k)	Radius (n) Inscribed Circle.	Radius (t) Circumscribed Circle.
Trigon..........	3	.4330127	.2886751	.5773503
Tetragon........	4	1.0000000	.5000000	.7071068
Pentagon........	5	1.7204774	.6881910	.8506508
Hexagon..........	6	2.5980762	.8660254	1.0000000
Heptagon........	7	3.6339124	1.0382617	1.1523824
Octagon..........	8	4.8284271	1.2071068	1.3065628
Nonagon..........	9	6.1818242	1.3737387	1.4619022
Decagon..........	10	7.6942088	1.5388418	1.6180340
Undecagon.......	11	9.3656399	1.2028437	1.7747324
Dodecagon.......	12	11.1961524	1.8660254	1.9318517

21. A side (a) of a regular polygon being given, required the area (c).
$k \times a^2 = c.$

22. A side (a) of a regular polygon being given, required the radius (r) of an inscribed circle:
$n \times a = r.$

23. A side (a) of a regular polygon being given, required the radius (r) of a circumscribed circle:
$t \times a = r.$

24. The diameter (d) of a sphere being given, required its surface (s):
$d \times 3.1416 \times d = s.$

25. The diameter (d) of a sphere being given, required its cubic contents (c):
$d^3 \times .5236 = c.$

26. The greater (a) and less (b) diameters of an oblate spheroid being given, required its cubic contents (c).
$a^2 \times b \times .5236 = c.$

27. The greater (a) and less (b) diameters of a prolate spheroid being given, required its cubic contents (c):
$b^2 \times a \times .5236 = c.$

28. The diameter (d) and altitude (a) of a paraboloid being given, required its cubic contents (c)
$d^2 \times a \times .3927 = c.$

29. The length (a) and diameter (d) of a cylinder being given, required its convex surface (s):
$d \times 3.1416 \times a = s.$

30. The length (a) and diameter (d) of a cylinder being given, required its cubic contents (c):
$d^2 \times .7854 \times a = c.$

31. The diameter (d) of the base and the slant height (a) of a cone being given, required its convex surface (s):
$d \times 3.1416 \times a \div 2 = s.$

32. The diameter (d) of the base and the altitude (a) of a cone being given, required its cubic contents (c):
$d^2 \times .7854 \times a \div 3 = c.$

33. The perimeter (a) of the base and the slant height (b) of a regular pyramid being given, required its slant surface (s):
$a \times b \div 2 = s.$

34. A side (b) of the base and the altitude (a) of a regular pyramid being given, required its cubic contents (c):
$k \times b^2 \times a \div 3 = c.$

35. The greater (a) and less (b) diameters, and the slant heighth (c) of the frustum of a cone being given, required its convex surface (s):
$(a \times 3.1416) + (b \times 3.1416) \div 2 \times c = s.$

36. The perimeter (a) of the greater base, the perimeter (b) of the less base, and the slant height (c) of the frustum of a regular pyramid being given, required the slant surface (s):
$a + b \div 2 \times c = s.$

37. The greater (a) and less (b) diameters, and the altitude (d) of the frustrum of a cone being given, required its cubic contents (c):
$a^2 + b^2 + (a \times b) \times .7854 \times d \div 3 = c.$

38. A side (a) of the greater base, a side (b) of the lesser base and the altitude (c) of the frustrum of a regular pyramid being given, required the cubic contents (d.)

$$a^2+b^2+(a\times b)\times k\times c\div 3=d.$$

39. The perimeter (a) of the base and the altitude (b) of a prism being given, required the convex surface (s):

$$a\times b=s.$$

40. A side (a) of the base and the altitude (b) of a regular prism being given, required its cubic contents (c):

$$k\times a^2\times b=c.$$

TABLE OF REGULAR POLYHEDRONS.

NAME.	No. Faces	Surface (v) Edge of Polyhedron being one.	Cubic Contents (x) Edge of Polyhedron being one.	Diameter (y) Inscribed Sphere being 1 the Edge of Polyhedron is	Diameter (z) Circumscribed Sphere being one the Edge of Polyhedron is
Tetrahedron..	4	1.7320508	.1178513	2.4494897	.8164966
Hexahedron..	6	6.0000000	1.0000000	1.0000000	.5773503
Octahedron ..	8	3.4641016	.4714045	1.2247447	.7071068
Dodecahedron	12	20.6457288	7.6631189	.4490279	.3568221
Icosahedron..	20	.8.6602540	2.1816950	.6615845	.5257309

41. An edge (a) of a regular polyhedron being given, required its surface (s):

$$v\times a^2=s.$$

42. An edge (a) of a regular polyhedron being given, require its cubic contents (c).

$$x\times a^3=c.$$

43. The diameter (d) of an inscribed sphere being given, required the edge (a) of the circumscribing polyhedron:

$$y\times d=a.$$

44. The diameter (d) of a circumscribed sphere being given, required the edge (a) of the inscribing polyhedron:

$$z\times d=a.$$

NUMERALS, OR NOTATION.

	Arabic.	Rom.		Arabic.	Rom.		Arabic.	Rom.
Naught	0		Thirteen	13	XIII	Eighty	80	LXXX
One	1	I	Fourteen	14	XIV	Ninety	90	XC
Two	2	II	Fifteen	15	XV	One hundred	100	C
Three	3	III	Sixteen	16	XVI	Two hundred	200	CC
Four	4	IV	Seventeen	17	XVII	Three hundred	300	CCC
Five	5	V	Eighteen	18	XVIII	Four hundred	400	CCCC
Six	6	VI	Nineteen	19	XIX	Five hundred	500	D
Seven	7	VII	Twenty	20	XX	Six hundred	600	DC
Eight	8	VIII	Thirty	30	XXX	Seven hundred	700	DCC
Nine	9	IX	Forty	40	XL	Eight hundred	800	DCCC
Ten	10	X	Fifty	50	L	Nine hundred	900	CM
Eleven	11	XI	Sixty	60	LX	One thousand	1,000	M
Twelve	12	XII	Seventy	70	LXX	Two thousand	2,000	MM

	Arabic.	Rom.		Arabic,	Roman.
Three thousand	3,000	MMM	Fifty thousand	50,000	$\overline{\text{L}}$
Four thousand	4,000	$\overline{\text{IV}}$	Sixty thousand	60,000	$\overline{\text{LX}}$
Five thousand	5,000	$\overline{\text{V}}$	One hundred thousand	100,000	$\overline{\text{C}}$
Six thousand	6,000	$\overline{\text{VI}}$	One million	1,000,000	$\overline{\text{M}}$
Seven thousand	7,000	$\overline{\text{VII}}$	Ten million	10,000,000	CCCCCIƆƆƆƆƆ
Eight thousand	8,000	$\overline{\text{VIII}}$	One hundred million	100,000,000	CCCCCCIƆƆƆƆƆƆ
Nine thousand	9,000	$\overline{\text{IX}}$	One thousand million*	1,000,000,000	$\overline{\text{CCCCI}}$ƆƆƆƆ
Ten thousand	10,000	$\overline{\text{X}}$	One billion†	1,000,000,000,000	$\overline{\text{CCCCCCCI}}$ƆƆƆƆƆƆƆ

As often as a character is repeated, so many times is its value repeated.

A less character before a greater diminishes its value, as IV=I−V, or 1 subtracted from 5=4.

A less character after a greater increases its value, as XI=X+I, or 1 added 10=11.

For every Ɔ annexed the sum is increased 10 times.

For every C and Ɔ placed one at each end (of the character I), the sum becomes twice as many as the Ɔ placed singly.

A bar, thus ——, over any number increases it 1,000 times. Illustration.—10,000 =CCIƆƆ, or $\overline{\text{X}}$. 1883, MDCCCLXXXIII; 1,883,000 $\overline{\text{MDCCCLXXXIII}}$.

* French and American for a billion. † English

WEIGHTS AND MEASURES

LINEAR OR LONG MEASURE.

12 Inches = 1 Foot		*Inches.*		*Feet.*		*Yards.*		*Rods*		*Fur.*
3 Feet = 1 Yard	=	36								
5½ Yards = 1 Rod or Pole	=	198	=	16½						
40 Rods = 1 Furlong	=	7,920	=	660	=	220				
8 Furl'gs = 1 Mile (Statute)	=	63,360	=	5,280	=	1,760	=	320		
3 Miles = 1 League	=	190,080	=	15,840	=	5,280	=	960	=	24

The English Standard unit of long measure is the yard, which is determined from the length of a pendulum vibrating seconds of mean time in vacuo in London at the level of the sea. The measurement is made on a brass scale at a temperature of 62° Fahrenheit. The length of the pendulum thus measured is 39 13929 Imperial inches; the length of the standard yard is 36 inches of that measurement of inches.

The United States standard, of which the State standards are copies, is a brass scale 82 inches in length which is in the office of Weights and Measures at Washington; and was prepared in London for the survey of the coast of the United States. The English and United States standards are identical.

LENGTH OF A PENDULUM VIBRATING SECONDS AT THE LEVEL OF THE SEA IN VARIOUS PLACES.

	Latitude 00° 00′ 00″	39.0152 inches
	Latitude 45° 00′ 00″	39.1270 inches
Washington,	Latitude 38° 53′ 23″	39.0958 inches
New York,	Latitude 40° 42′ 40″	39.1017 inches
London,	Latitude 51° 31′ 00″	39.1393 inches
Stockholm,	Latitude 59° 21′ 30″	39.1845 inches

SURVEYORS' AND ENGINEERS' MEASURE.

7.92 Inches = 1 Link		*Inches.*		*Feet.*		*Yds.*		*Lks.*		*Rods.*
25 Links = 1 Rod *or* Pole	=	198	=	16½	=	5½				
4 Rods = 1 Chain	=	792	=	66	=	22	=	100		
80 Chains = 1 Mile (Statute)	=	63,360	=	5,280	=	1,760	=	8,000	=	320

Engineers use another chain which consists of 100 links, each one foot long.

MARINERS' MEASURE.

6 Feet	=	1 Fathom		*Feet.*		*Fths.*
120 Fathoms	=	1 Cable-length	=	720		
7⅓ Cable-lengths	=	1 Mile	=	5,280	=	880

1 Statute mile	=	5280 feet	=	0.8675806 Nautical mile
1 Nautical mile	=	6085.889568 feet	=	1.1526306 Statute mile
1 Equatorial degree	=	60 Nautical miles	=	69.1578372 Statute miles

The nautical term *knot* refers to a division of the log line which is used to ascertain a vessel's motion. The number of knots which run off the reel in half a minute shows the number of miles the vessel sails in one hour. When a vessel goes eight miles an hour she is said to make eight *knots*. (Nautical miles)

CIRCULAR MEASURE.

60 Seconds	= 1 Minute		"		'	°
60 Minutes	= 1 Degree	=	3,600			
30 Degrees	= 1 Sign	=	108,000 =	1,800		
12 Signs	= 1 Circle	=	1,296,000 =	21,600	=	360

Every circle, large or small, is divided into 360 equal parts, called degrees.
A degree has no fixed linear extent; it is always the 360th part of any circle to which it is applied.

$90° =$ a Quadrant, or Right Angle.
$60° =$ a Sextant; or $\frac{1}{6}$ of a circle.

TIME MEASURE.

			SECONDS.	MINUTES.		HOURS.
60 Seconds	= 1 Minute					
60 Minutes	= 1 Hour	=	3,600			
24 Hours	= 1 Day	=	86,400 =	1,440		
7 Days	= 1 Week	=	604,800 =	10,080	=	168
365 Days	= 1 Year	=	31,536,000 =	525,600	=	8,760
366 Days	= 1 Leap year	=	31,622,400 =	527,040	=	8,784

The time in which the earth makes one revolution is divided into 24 hours and $\frac{360°}{24} = 15°$ per hour.

RECKONING TIME FROM LONGITUDE.

To reduce longitude into time, divide the number of degrees, minutes and seconds by 15; the quotient is the time. This is equivalent to finding the difference in time between a designated longitude and the meridian.

EXAMPLE 1—Reduce the longitude of San Francisco into time.

Solution. 122° 24′ 53″ ÷ 15 = 8 hours, 9 minutes, 39.5 seconds.

To find the difference in time between two places divide the difference in longitude by 15; the quotient is the difference in time.

EXAMPLE 2—Required the difference in time between New York and San Francisco.

Solution—Longitude of San Francisco,	122° 24′ 53″
Longitude of New York,	74° 00′ 03″
Difference in Longitude,	48° 24′ 50″

48° 24′ 50″ ÷ 15 = 3 hours, 13 minutes, 39⅓ seconds, the difference in time. When it is 12 M. at the Russian Hill Observatory in San Francisco, it is 3 hrs. 13 min. 39⅓ sec. P. M. at the City Hall in New York.

TO DETERMINE LONGITUDE FROM TIME.

EXAMPLE 3—A vessel sails from New York to Liverpool, after having been at sea for one week, the difference in time with New York was found to be 1 h. 51 m. 45 s. Required the longitude from New York.

Solution. 1 h. 51 m. 45s. × 15 = 27° 56′ 15″ from New York.

PENDULUMS.

THE lengths of pendulums for different vibrations in the latitude of Washington are 39.0938 in. for one second; 9.774 in. for half a second; 4.344 in. for third of a second; 2.4435 in. for quarter of a second. At the equator, N. Y., Paris, London, and latitude 45 degrees, the pendulum is only a small fraction of an inch shorter or longer than at Washington.

Time Measure.—The standard unit of time is the sidereal day, 23 h. 56 m. 4.092 sec. in solar or mean time. Sidereal time is the period which elapses between time of a fixed star being in meridian of a place and time of its return to that place. Mean solar time is deduced from the time in which the earth revolves on its axis, as compared with the sun, making 365.242218 revolutions in a mean solar or Gregorian year.

Apparent time is shown by the sun-dial, and is deduced from observations of the sun.

The solar day is 24 hours 3 minutes 56.555 sec. in sideral time.

The civil day begins at midnight, and the astronomical day at noon of the civil day, 12 hours later.

The marine day begins 12 hours before civil time or one day before the astronomical.

Solar equinoctial, tropical, civil or calendar year is the time in which the sun returns from one vernal equinox to another, and its average time is 365.242218 solar days, or 365 days, 5 hours, 48 minutes, and 47.6 seconds.

The mean lunar month is 29 days, 12 h'rs, 44 min., 2 seconds, and 5.24 thirds.

Gregorian or New Style is now adopted by all Christian countries except Russia and Greece.

Standard time for the five divisions of the U. S. went into effect Nov. 18, 1883. When the sun crosses the 75th meridian at Washington, it is noon, and the difference from E. to W. for every 15 degrees is just one hour, so that when it is noon or 12 M. in New York it is 8 A. M. in San Francisco.

TIDES.

The elevation of a tidal wave towards the moon slightly exceeds that of the opposite one, and the intensity of it diminishes from equator to the poles. The sun by its action twice elevates and depresses the sea every day, following the action of the moon, but with less effect. Spring tides arise from the combined action of the sun and moon when they are on the same side of the earth. Neap tides arise from the divided action of the sun and moon, when they are on opposite sides of the earth, and the greatest elevations and depressions do not occur until the second or third day after a full or new moon. When the sun and moon are in conjunction, and the time is near the equinoxes, the tides are highest. The mean effect of the moon on the tidal wave is 4.5 times that of the sun. The various conformations of shores, straits, capes, rivers, lengths and depths of channels, shoals, etc., disturb the general rules. A rolling wave 20 feet high will exert a force about one ton per square foot. The action of waves is most destructive at low water line. Waves of oscillation, when reflected, will produce no effect at a depth of 12 feet below the surface. Waves of translation are nearly as powerful at a great depth as at the surface. The semi-diurnal or free tide wave is produced by the action of sun and moon, and its period is about 12 hours and 24 minutes.

Tides and Waves.—The rise of water which takes place in tidal rivers is not due to the direct action of the moon on their waters, but in consequence of the change of level in the surface of the ocean, caused by the tidal wave passing the mouth of the river. The direction of strong winds, as well as the varying pressure of the atmosphere, considerably affects both the times and the heights of high water. The tidal wave in the deep sea is merely an undulation; but, when shallow seas or bays are reached, the movement of the water is discernible. The general principle is, that in the deep sea there is a quick movement of the wave and a slow movement of the water; in the shallow sea there is a slow movement of the wave and a quick movement of the water, which is called the Tidal Current. Such currents have much to do with the formation of bars at the mouth of rivers. Therefore, unless the harbor engineer have a full knowledge of their set and force, and of their conjunction with or opposition to Ocean Currents, his plans of improvement may be rendered abortive.

THE PLANETS.

NAME.	Diameter.	Mean Distance from Sun.	Least Distance from Earth.	Greatest Distance from Earth.	No. of Days in its Year.
	Miles.	*Miles.*	*Miles.*	*Miles.*	
Mercury...	2,962	35,000,000	47,000,000	136,000,000	88
Venus.....	7,510	66,000,000	23,000,000	160,000,000	225
Earth......	7,916	91,000,000	....	....	365
Mars.......	4,920	139,000,000	62,000,000	245,000,000	687
Jupiter...	85,390	476,000,000	419,000,000	952,000,000	4,333
Saturn	71,904	872,000,000	831,000,000	1,014,000,000	10,759
Uranus...	33,024	1,753,000,000	1,746,000,000	1,929,000,000	30,687
Neptune...	36,620	2,746,000,000	2,629,000,000	2,863,000,000	60,127

It is supposed that A^2 Centauri, one of the brightest stars of the Southern Hemisphere, is the nearest fixed star to the earth. Its distance from the earth is reckoned to be 20,000,000,000 miles. A ray of light from this star is 3 years and 3 months in reaching the earth.

Magnetic Pole is nearer to the U. S. by 1,400 miles than the geographical pole, and is the pole of Aurora Borealis or center of greatest electrical manifestation. This center is now due north of U. S., but is constantly changing from E. to W., and 400 years ago was near Spitzbergen. At this magnetic pole the compass needle refuses to perform its regular function, and the dip needle in a vertical plane stands straight.

SQUARE OR SURFACE MEASURE.

144	Square Inches (sq. in.)	=1 Square Foot,	sq. ft
9	Square Feet,	=1 Square Yard,	sq. yd.
30¼	Square Yards,	=1 Square Rod, or Perch,	sq. rd. p.
40	Square Rods, or Perches	= 1 Rood,	r
4	Roods,	= 1 Acre,	a
640	Acres	= 1 Square Mile,	sp. m
36	Square Miles, (6 miles sq.)	= 1 Township,	T
16	Perches,	= 1 Square Chain,	sq. ch.
10	Square Chains,	= 1 Acre,	a.

	SQUARE INCHES.	SQUARE FEET.	SQUARE YARDS.	SQUARE RODS.
1 Square Foot =	144			
1 Square Yard =	1,296=	9		
1 Square Rod =	39,204=	272¼=	30¼	
1 Square Chain =	627,264=	4,356 =	484 =	16
1 Rood =	1,568,160=	10,890 =	1,210 =	40
1 Acre =	6,272,640=	43,560 =	4,840 =	160
1 Square Mile =	4,014,489,600=	27,878,400 =	3,097,600 =	102,400
1 Township =	144,521,625,600=	1,003,622,400 =	111,513,600 =	3,686,400

A square, as used by mechanics, is 10 feet square, or 100 square feet.

More frequently than many might suppose, square inches and inches square, square feet and feet square, etc., are regarded as being of no difference. By 9 feet square is meant a square figure each side of which is 9 feet; but by 9 square feet is meant 9 small squares, each 1 foot long and 1 foot wide. It will then be seen that there is no difference between 1 foot square and 1 square foot; but by increasing the number above 1, the difference rapidly increases.

The difference between 5 feet square and 5 square feet is 20 square feet.

The difference between 1,000 feet square and 1,000 square feet 999,000 square feet.

CUBIC, OR SOLID MEASURE.

1,728	Cubic Inches	= 1 Cubic Foot.
27	Cubic Feet	= 1 Cubic Yard.
16	Cubic Feet	= 1 Cord foot.
8	Cord Feet	= 1 Cord of Wood.
24¾	Cubic feet, *or* 16½ feet long, 1½ feet high and 1 foot wide	= 1 Perch.
40 50	Cubic Feet of round timber, *or* Cubic Feet of hewn timber	= 1 Ton or Load.

A cubic yard of earth is called a load.

A square of earth is a cube measuring 6 feet on each side, and is equivalent to 216 cubic feet.

In civil engineering the cubic yard is the unit to which estimates for excavations, embankments and levees are reduced.

In commerce, the cubic foot is often the unit on which charges are estimated and made for freight, the space occupied being measured.

ORIGIN OF TROY AND AVOIRDUPOIS WEIGHTS.

From the time of William I to Henry VII of England, the standard of weight was determined by the weight of grains of wheat; 32 grains taken from the middle of the ear and well dried, made the weight of a penny, or a pennyweight, 20 pennyweights an ounce, and 12 ounces a pound. Henry VII changed this weight and introduced another pound in its place, which was ¾ of an ounce heavier than the old pound. The same divisions were retained, but the number of grains in a pennyweight was changed to 24; although the name was still used, it had no reference to the weight of grains of wheat. This is the Troy pound of the present time.

Henry VIII introduced another weight, for the purpose of weighing meat in the market, which is the Avoirdupois pound of the present time.

TROY OR MINT WEIGHT.

24 Grains	=	1 Pennyweight.		*Grains.*		*Pennyweights.*
20 Pennyweights	=	1 Ounce.	=	480		
12 Ounces	=	1 Pound.	=	5,760	=	240

The Troy pound is the standard unit of weight of the United States Mint. It is identical with the Troy pound of England and derives its name from Troy Novant, the ancient name of the city of London.

The Troy pound is equivalent to the weight of 22.79442 cubic inches of distilled water, at its maximum density, or 22.8157 cubic inches, 62° Fahrenheit, barometer at 30 inches, in both cases.

SIDE OF A SQUARE CONTAINING A GIVEN NUMBER OF ACRES.

Acres.	Side.		Acres.	Side.		Acres.	Side.		Acres.	Side.	
	Ft.	*In.*		*Ft.*	*In.*		*Ft.*	*In.*		*Ft.*	*In.*
1-640	8	3	3½...	390	5½	10¼...	638	2⅜	17½...	873	1⅛
1-360	11		3 3-5.	396		10½...	676	3⅝	17¾...	879	3¾
1-160	16	6	3¾...	404	2	10¾...	684	3⅝	18 ...	885	5⅞
1-90.	22		4 ...	417	5	11 ...	692	2½	18¼...	891	7⅜
1-40.	33		4¼...	430	3¼	11¼...	700	⅜	18½...	897	9⅝
2-45.	44		4½...	442	8⅞	11½...	707	9¼	18¾...	903	9
5-72.	55		4¾...	454	10½	11¾...	715	5	19 ...	909	9
1-10.	66		5 ...	466	8¼	12 ...	722	11⅞	19¼...	915	7¼
⅛...	73	9½	5¼...	478	2⅝	12¼...	730	5⅞	19½...	921	7½
9-40.	99		5½...	489	5⅝	12½...	737	10¾	19¾...	927	6½
¼...	104	4¼	5⅝...	495		12¾...	745	2⅞	20 ...	933	4⅜
5-18.	110		5¾...	500	5⅝	13 ...	752	6⅛	20¼...	939	2¼
⅜...	127	9¾	6 ...	511	2¾	13¼...	759	8⅝	20½...	944	10⅝
2-5..	132		6¼...	521	9¼	13½...	766	10¼	20¾...	950	8⅝
½...	147	7	6 2-5.	528		13¾...	773	11	21 ...	956	5⅛
⅝...	165		6½...	532	1¼	14 ...	780	11⅛	21¼...	962	2
¾...	180	9	6¾...	542	3	14¼...	787	10¼	21½...	967	9
⅞...	195	2¾	7 ...	552	2⅜	14 2-5.	792		21¾...	973	4¼
9-10.	198		7¼...	561	11⅝	14½...	794	8⅞	22 ...	978	10⅛
1.....	208	8½	7½...	571	6⅞	14¾...	801	6¾	22¼...	984	5¾
1¼...	233	4⅛	7¾...	581	¼	15 ...	808	4	22½...	990	
1½...	255	7⅜	8 ...	590	3⅞	15¼...	815	½	22¾...	995	5¾
1 3-5..	264		8¼...	599	5⅝	15½...	821	8¼	23 ...	1000	10¼
1¾....	276	1⅛	8½...	608	5⅞	15¾...	828	3½	23¼...	1006	4⅜
2.....	295	1⅞	8¾...	617	4½	16 ...	834	10⅛	23½...	1011	9⅛
2¼...	313	¾	9 ...	626	1½	16¼...	841	4	23¾...	1017	1½
2½...	330		9¼...	634	9¼	16½...	847	9⅜	24 ...	1022	5½
2¾...	346	1¼	9½...	643	3⅜	16¾...	854	2⅛	24¼...	1027	9⅜
3.....	361	6	9¾...	651	8⅜	17 ...	860	6⅜	24½...	1033	¾
3¼...	376	3⅛	10 ...	660		17¼...	866	10	25 3-5.	1056	

The number of acres (a) in a square piece of ground being given required the length of a side of the square in feet (s).

$$\sqrt{43560 \times a} = s.$$

HILLS IN THE AREA OF AN ACRE.

Feet Apart.	Number.	Feet Apart.	Number.	Feet Apart.	Number.	Feet Apart.	Number.
1	43560	5	1742	9	538	16	170
1½	19360	5½	1440	9½	482	17	151
2	10890	6	1210	10	435	18	134
2½	6969	6½	1031	10½	394	20	108
3	4840	7	889	12	302	25	69
3½	3556	7½	775	13	258	30	48
4	2722	8	680	14	225	35	35
4½	2151	8½	602	15	193	40	27

AVOIRDUPOIS WEIGHT.

SHORT TON.

				Grains.	*Drams.*	*Ozs.*	*Lbs.*	*Qrs.*
$27\frac{11}{32}$	Grains	=	1 Dram					
16	Drams	=	1 Ounce	= 437.5				
16	Ounces	=	1 Pound	= 7,000	= 256			
25	Pounds	=	1 Q'rter	= 175,000	= 6,400	= 400		
4	Quarters	=	1 Cwt.	700,000	= 25,600	= 1,600	= 100	
20	Cwt.	=	1 Ton	= 14,000,000	= 512,000	= 32,000	= 2,000	= 80

ENGLISH OR LONG TON.

				Grains.	*Drams.*	*Ozs.*	*Lbs.*
$27\frac{11}{32}$	Grains	=	1 Dram				
16	Drams	=	1 Ounce	= 437.5			
16	Ounces	=	1 Pound	= 7,000	= 256		
112	Pounds	=	1 Cwt.	= 784,000	= 28,672	= 1,792	
20	Cwt.	=	1 Ton	= 15,680,000	= 573,440	= 35,840	= 2,240

The avoirdupois weight of the United States and England are identical. They rest in fact upon existing pieces of brass which have been declared by law to be the units of the system; and 252.458 of these units are supposed to be exactly equal in weight to a cubic inch of distilled water when the conditions named below are observed.

1 cubic inch of distilled water at its maximum density = 252.693 grains; or, 252.458 grains 62° Fahrenheit, barometer at 30 inches in both cases.

1 cubic foot of distilled water at its maximum density = 62.37907 pounds Avoirdupois; or, 62.32104 pounds Avoirdupois 62° Fahrenheit, barometer at 30 inches in both cases.

1 pound Avoirdupois = 27.7015 cubic inches of distilled water at its maximum density; or, 27.7274 cubic inches 62° Fahrenheit, barometer at 30 inches in both cases.

RELATIVE VALUE OF AVOIRDUPOIS AND TROY WEIGHTS.

Avoirdupois Ozs. Reduced to Grains & Troy Weights.					Troy Ozs. Reduced to Grains & Avoirdupois Weights.				
AVOIRDUPOIS.		TROY.			TROY.		AVOIRDUPOIS.		
Ozs. =	Grs. =	Ozs.	Pwts.	Grs.	Ozs. =	Grs. =	Ozs.	*Drms.*	Grs.
1	437 5		18	5.5	1	480	1	1	15.15625
2	875	1	16	11	2	960	2	3	2.96875
3	1,312.5	2	14	16.5	3	1,440	3	4	18.12500
4	1,750	3	12	22	4	1,920	4	6	5.93750
5	2,187.5	4	11	3.5	5	2,400	5	7	21.09375
6	2,625	5	9	9	6	2,880	6	9	8.90625
7	3,062.5	6	7	14.5	7	3,360	7	10	24.06250
8	3.500	7	5	20	8	3,840	8	12	11.87500
9	3,937.5	8	4	1.5	9	4,320	9	13	27.03125
10	4,375	9	2	7	10	4,800	10	15	14.84375
11	4.812.5	10		12.5	11	5,280	12	1	2.65625
12	5,250	10	18	18	12	5,760	13	2	17.81250
13	5,687.5	11	16	23.5					
14	6,125	12	15	5					
15	6,562.5	13	13	10.5					
16	7,000	14	11	16					

1 dram Avoirdupois = $27\frac{11}{32}$ or 27.34375 grains.

1 pound Avoirdupois = $\frac{175}{144}$ of 1 pound Troy.

1 ounce Avoirdupois = $\frac{175}{192}$ of 1 ounce Troy.

APOTHECARIES' WEIGHT.

20 Grains—(gr.)	=	1 Scruple	=	gr.		℈		ʒ		
3 Scruples—(℈)	=	1 Dram	=	60						
8 Drams—(ʒ)	=	1 Ounce	=	480	=	24				
12 Ounces—(℥)	=	1 Pound	=	5,760	=	288	=	96		

The grain, the ounce and the pound of this weight are the same as those of Troy weight.

MEDICAL DIVISIONS OF THE GALLON.

60 Minims—(M)	=	1 Fluidram		M		f ʒ		f ℥
8 Fluidrams—(f ʒ)	=	1 Fluidounce	=	480				
16 Fluidounces—(f ℥)	=	1 Pint	=	7,680	=	128		
8 Pints—(O)	=	1 Gallon (Cong.)	=	61,440	=	1,024	=	128

O is an abbreviation of *octans*, the Latin for one-eighth; *Cong.* for *congiarium*, the Latin for gallon.

1 Common teaspoonful	=	45 drops.
· 1 Common teaspoonful	=	¼ common tablespoonful = 1 fluidram.
1 Common tablespoonful	=	⅛ common teacup = about ½ fluidounce.
1 Common teacup	=	about 4 fluidounces.
1 Pint of water	=	about 1 pound.

℞ is an abbreviation for *recipe*, or take; ā̄ aa., for equal quantities; j. for 1; ij. for 2; iij. for 3; *ss.* for *semi*, or half; gr. for grain; P for *particula*, or little part; P. æq. for equal parts; q. p., as much as you please.

LIQUID MEASURE.

4	Gills	=	1 Pint		*Gills.*		*Pints.*		*Quarts.*		*Gallons.*
2	Pints	=	1 Quart	=	8						
4	Quarts	=	1 Gallon	=	32	=	8				
31½	Gallons	=	1 Barrel	=	1,008	=	252	=	126		
2	Barrels	=	1 Hogshead	=	2,016	=	504	=	252	=	63

The United States standard unit for liquid measure is the gallon=231 cubic inches=8.3388822 pounds of the standard pound avoirdupois of distilled water.

The English standard is the Imperial gallon=277.2738 cubic inches=10 pounds avoirdupois of the standard pound avoirdupois of distilled water.

In some States the barrel is estimated at 31½ gallons, and in others at 32.28.

DRY MEASURE.

2 Pints	=	1 Quart		*Pints.*		*Quarts.*
8 Quarts	=	1 Peck	=	16		
4 Pecks	=	1 Bushel	=	64	=	32

The United States standard unit for dry measure is the old English Winchester bushel, and contains 2,150.42 cubic inches or 77.627413 pounds, of the standard pound avoirdupois of distilled water.

The heaped bushel, the cone of which is 6 inches above the brim of the measure, contains 2,747.7 cubic inches.

In New York a bushel contains 2,218.191 cubic inches, which is the same as the Imperial bushel of England. 33 English or Imperial bushels are equal to 34.04 Winchester or United States bushels.

WHEAT GRADES.

Weight, color and cleanliness are the principal considerations in determining the grade of wheat.

The word *club* is used in America and other countries to designate a kind or species of wheat, but in Liverpool it is used only to designate the best quality or the highest grade, and in that market any kind or species of wheat of the quality of the grade is called Club Wheat.

In Liverpool the grades are *Club* and *Average*, and buyers are further guided by subdivisions of these grades.

LIVERPOOL WHEAT GRADES.

Grades.		First Division.		Second Division.		Color.	Cleanliness.
No.	Name.	No.	Name.	No.	Weight per Bushel.		
1	Club.....	1	Choice.....	1	63 lbs.	Extra White	Clean.
		2	Common.	1	63 lbs.	White....	Clean.
				2	63 lbs.	Light.....	Clean.
2	Average..	1	Choice....	1	63 lbs.	Dark.....	Clean.
				2	63 lbs.	Dark.....	Mixed with dust and other grain.
				3	60 lbs.	Light.....	Clean.
				4	60 lbs.	Dark.....	Clean.
		2	Common.	1	60 lbs.	Dark.....	Mixed with dust and other grain.
				2	57½ lbs.	Light.....	Clean.
				3	57½ lbs.	Dark.....	Clean.
				4	57½ lbs.	Dark.....	Mixed with dust and other grain.

In some of the wheat-growing districts of California buyers have introduced three grades, which have been adopted only to a limited extent, they are:

1. Weight, 63 pounds; Color, light; Clean.
2. Weight, 62 pounds; Color, dark; Clean.
3. Weight, 57½ pounds; Color, dark; Mixed with dust and other grain.

THE ENGLISH QUARTER. --The English Quarter, at which wheat is quoted in the English reports, is 560 pounds, or one-fourth of the ton gross weight of 2,240 pounds. The English legal bushel is 70 pounds, and consequently 8 of those bushels is a quarter—equal to 9⅓ of our statute bushels of 60 pounds.

WEIGHT OF GRAIN, PRODUCE, ETC., PER BUSHEL.

Minimum Weight according to the Laws of the United States.

Wheat............	per bushel	......60 lbs	Clover Seed..........	per bushel	..60 lbs
Corn, in the ear..	"	......70 lbs	Flax Seed............	"	..56 lbs
Corn, shelled.....	"	......56 lbs	Millett Seed..........	"	..50 lbs
Rye..............	"	......56 lbs	Hungarian Grass Seed	"	..50 lbs
Buckwheat..	"	......48 lbs	Timothy Seed........	"	..45 lbs
Barley...........	"	......48 lbs	Blue Grass Seed......	"	..44 lbs
Oats	"	......32 lbs	Hemp Seed...........	"	..44 lbs
Peas	"	......60 lbs	Fine Salt	"	.167 lbs
White Beans.....	"	......60 lbs	Salt,coarse	"	.151 lbs
Castor Beans.....	"	......46 lbs	Corn Meal	"	..48 lbs
Irish Potatoes....	"	......60 lbs	Ground Peas.........	"	..24 lbs
Sweet Potatoes...	"	......55 lbs	Malt.	"	..38 lbs
Onions	"	......57 lbs	Bran.................	"	..20 lbs
Turnips..........	"	......55 lbs	Stone Coal...........	"	..80 lbs
Dried Peaches....	"	......33 lbs	Lime, unslacked.. ...	"	..30 lbs
Dried Apples.....	"	......26 lbs	Plastering Hair......	"	.. 8 lbs

The number of United States bushels in a quanty of grain is equal to its measurement in cubic inches divided by 2,150.42.

EXAMPLE 1. Required the number of bushels in a bin even full of grain the inside dimensions being—length, 12 feet; width, 7 feet 5 inches; depth, 6 feet 6 inches.

Solution. Reduce to inches. $144 \times 89 \times 78 \div 2150.42 = 464.86$ bushels.

In measuring fruit, vegetables and other substances, the "heaped bushel" is the measurement; for this divide the number of cubic inches by 2,747."

Note.—For bins of wheat where machinery causes jar, add 6% to 9% to the above solution. Still bins filled with No. 1 wheat, add 2½%.

Foreign Weights and Measures in U. S. Equivalents.

Abyssinia.*

1 Pic, stambouili...26.8 ins.
1 Pic, geometri'l...30.37 "
1 Wakea..................400 grs.
1 Mocha..............1 oz., troy
1 Rottolo.........10 ozs., troy
1 Madega..........3,466 bush.
1 Ardeb..............34.66 bush
1 Ardeb-Musah...83.184 "

Africa, Alexandria, Cairo and Egypt.

1 Cubit .... 20.65 ins.
1 Derah............... 25.49 "
1 Pic....................21.25 "
1 Pic, geometric...29.53 "
1 Kassaba..............11.65 ft.
1 Mile..................2,146 yds.
1 Feddan al-risach.........
.... .55248 acre
1 Feddan.............1.03 acres
1 Rottol............. .9821 lb.
1 Oka..................2.7235 lbs.
1 Roobak...........1.684 gals.
1 Ardeb...........7.6907 bush.
1 Maragha.........15° or 1 hr.

Aleppo and Syria.

1 Dra Mesrour.....21.845 ins.
1 Pic.....................26.63 "
Road measures are computed by time.

Algeria.†

1 Rob (Turkish).....3.11 ins.
1 Pic (Arabic).......18.89 "
1 Pic (Turkish)....24.92 "

Alicante, Spain.

1 Palmo... ....8.908 ins.
1 Vara............... 35.632 "

Amsterdam, Holland.

1 Voet ....11.144 ins.
1 El.....................21.979 "
1 Faden....................5.57 ft.
1 Lieue............... 6.383 yds.
1 Maat...............1.6728 acres
1 Morgen............2.0095 "
1 Vat..................40 cub. ft.

Antwerp, Belgium.

1 Fuss................11.275 ins.
1 Elle (cloth)........26.94 "
1 Bonnier.........3.2507 acres
1 Corde........ 24.494 cub. ft.

Arabia (Mocha) and Basoria, Turkey.‡

1 Foot, Arabic......1.0502 ft.
1 Covid, Mocha.......19 ins.
1 Guz.......................25 "
1 Kassaba................12.3 ft.
1 Mile, 6,000 ft. 2,146 yds.
1 Farsakh.............5,280 "
1 Baryd...............21,120 "
1 Feddan.........57,600 sq. ft.
1 Noosfia, Arabic...........
.... 138 cu. ins.
1 Maund....................3 lbs.
1 Tomand ....168 "
1 Gudda...................2 gals.

Argentine Republic.§†

1 Pie. 11.3736 ins=0.9478 ft
1 Vara...........34.12 ins.
1 Legua...........3.266 ft.
1 Arroba...............25.36 lbs.
1 Quintal.............101.42 "
1 Cuadra....................4.2 acres
1 Suertes de Estancia......
...............27,000 sq. varas
1 Baril.............20.0787 gals.
1 Fanega..............1.5 bush.

Australasia.

1 Land Section......80 acres

Austria.†

1 Zoll..................1.0371 ins.
1 Fuss..................1.0371 ft.
1 Meile............... 8,000 yds.
1 Jochart.........6.884 sq. "
1 Klafter, quadrat..........
..................35.854 sq. "
1 Cube Fuss.....1.1155 cu. ft.
1 Unze............... .0.8642 grs.
1 Pfund......... ......1.2347 lb.
1 Centner............123.47 lbs.
1 Achtel..............1.692 gals.
1 Viertel............3.1143 "
1 Eimer.............12.774 "
1 Metze............1.6918 bush.

Baden.†

1 Fuss..................11.81 ins,
1 Klafter.............. 5.9055 ft.
1 Ruthe ....9 8427 "
1 Stunden............4,860 yds.
1 Morgen...........0.8896 acre
1 Pfund ....1.1023 lbs.
1 Stutze............ 3.3014 gals.
1 Malter.......... 4.1268 bush.

Barbary States.

1 Pic, Tunis linen.18.62 ins.
1 " " cloth..26.49 "
1 " Tripoli........21.75 "

Bavaria †

1 Fuss..................11.49 ins.
1 Klafter.............5.74536 ft.
1 Ruthe...............3.1918 yds.
1 Meile.................8,060 "
1 Ruthe quadrat.............
................10.1876 sq. yds.
1 Morgan (Tagwerk). .....
......................0.8410 acre
1 Kubic Klafter..............
..................4.097 cu. yds.
1 Pfund................8,642 grs.
1 Eimer......... 15.05856 gals.
1 Scheffel (dry)...6.119 gals
1 Metze ....1.0196 bush.

Belgium and Holland.†

1 Meile................2.132 yds.
1 Last...............85.134 bush.

Bengal, Bombay and Calcutta.

1 Moot................. .... .3 ins.
1 Span......... ....9 "
1 Ady, Malabar....10.46 "
1 Hath............ ....18 "
1 Guz, Bombay.........27 ins.
1 " Bengal.........36 "
1 Corah, minim......3.417 ft.
1 Coss, Bengal......1.136 mi.
1 " Calcutta...1.2273 "
1 Kutty.........9.8175 sq. yds.
1 Biggah, Bengal............
.............................0.3306 acre
1 Biggah, Bombay..........
.........................0.8114 acre
1 Seer, Factory..0.68 cu. in.
1 Covit, Bombay ....
.....................12.704 cu. ft.
1 Maund, Bombay..........
...................28 lbs. avoir.
1 Maund, Bengal............
..............82.285 lbs. avoir.
1 Candy, Bombay...........
..................560 lbs. avoir.
1 Seer, Bombay .....1.234 pt.
1 Parah.............4.4802 gals.
1 Mooda.........112.0045 "
Liquids and grain measured by weight.

Bohemia.

1 Foot, Prague.....11.88 ins.
1 " Imperial...12.45 "
Also same as Austria.

Bolivia, Chile and Peru.†

1 Vara................33.367 ins.
1 Fanegada.....1.5888 acres
1 Libra ....1.014 lb.
1 Arroba...............25.36 lbs.
1 Quintal.......... .101.61 "
1 Fanega, Peru.140 Cas. "
1 Gallon.................0.74 gal.
1 Fanega............1.572 gals.

Brazil.

1 Palmo, Bahia...8.5592 ins.
1 Vara ....3.566 ft.
1 Braca...................7.132 "
1 Geora...............1.448 acre
1 Arroba...............32.38 lbs.
1 Quintal 130.06 lbs. avoir.

Burmah.

1 Paulgat....................1 in.
1 Dain.................4.277 yds.
1 Viss.......................3.6 lbs.
1 Taim. ....5.5 "
1 Saading..................22 "
Also same as England.

Canary Islands.

1 Onza........ .... 0.927 in.
1 Pic, Castilian...11.128 ins.
1 Almude...........0.0416 acre
1 Fanegada............0.5 "
1 Libra..................1.0148 lb.

Cape of Good Hope.

1 Foot..................11.616 ins.
1 Morgen........2.11654 acres

Ceylon.

1 Seer.............. ....1 qt.
1 Parrah...............5.62 gals.
Also same as England.

* Also same as Egypt and Cairo. † Also Metric System. ‡ Other measures like those of Egypt; see Africa, etc. § Includes Buenos Ayres, Paraguay, Uruguay, and Patagonia. ‖ All other measures same as English.

Foreign Weights and Measures, Etc.—Continued.

China.

1 Fen ....0.141 in.
1 Li (small)............0.486 "
1 Tsun....................1.41 "
1 Chih, engineers' 12.71 ins.
1 " or Covid...13.125 "
1 " legal..... ......14.1 "
1 Pu.......................4.05 ft.
1 Chang..................11.75 "
1 Li (large)...............486 "
1348+Chang............1 mile
1 Chang, fathom..10.9375 ft.
1 Li (sq. meas.)...7.26 sq. "
1 Hao (sq. meas).72.6 " "
1 Pu or Kung (sq. meas.) .... 3.32 sq. yds.
1 Fen (sq. meas.) 726 sq. ft.
1 Mu or Mau (sq. meas.) ....1.6 acre
1 King, 100 Mu 16,485 acres
1 Fen (avoir.)......5.8333 grs.
1 Tsein (avoir.)..58.333 "
1 Liang or Tael......1.333 oz.
1 Kin or Catty.........1⅓ lb.
1 Tan or Picul......133⅓ lbs.
1 Tau.....................1.13 gal.

Note.—In the coast towns of China these weights are called by their Malaynames, viz.: Candareen (for Fen), Mace (for Tsien), Tael (for Liang), Catty (for Kin), and Picul (for Tan).

Cochin China.

1 Thuoc or Cubit...19.2 ins.
1 Sao...................64 sq. yds.
1 Mao...................1.32 acres
1 Tael (Troy)......590.75 grs.
1 Nen (avoir.).......0.8594 lb.
1 Hao..................6.222 gals.
1 Shita................12.444 "

Colombia and Venezuela.*

1 Vara.............. 33.384 ins.
1 Libra................1.0161 lb.
1 Oncha....................25 lbs.

Denmark, Greenland, Iceland and Norway.*

1 Tomme..............1.0297 in.
1 Fod....................1.0297 ft.
1 Favn, 3 Alen...6.1783 "
1 Mil ....4.68055 m's
1 Mil, nautical...4.61072 "
1 Pund......... ....1.1023 lb.
1 Lispund...........17.367 lbs.
1 Centner ....110.11 "
1 Anker............8.0709 gals.
1 Skeppe..........0.478 bush.
1 Fjerdingkar...0.9558 "
1 Tonde...........3.94783 "

Genoa, Sardinia and Turin.

1 Oncie...................1.686 in.
1 Palmo..............9.8076 ins.
1 Piede, Manual..13.488 "
1 Piede, Liprando............ .... 20.23 ins.
1 Trabuco, Tesa.....10.113 ft.
1 Miglio............1.3835 mile
1 Giomaba..........0.9394 acre
1 Starello...........0.9804 "

France.

See Index for Metric System.

Germany.*

The old measures of each State differ; but generally,
1 Foot Rhineland.......... ....12.357 ins.
1 Meile..............4.603 miles

Greece.*

1 Pike.......................27 ins
1 Stadium..........0.6155 mile
1 Stremma ....¼ acre
1 Livre.................. 1.1 lb.
1 Oke.......................2.8 lbs.
1 Cantar................123.2 "
1 Baril (wine).....16.33 gals.
1 Kilo...............1.064 bush.

Hamburg.*

1 Fuss................11.2788 ins.
1 Klafter.. ....5.6413 ft.
1 Morgan ....2.386 acres
1 Cube Fuss.....0.8311 cu. ft
1 Tehr..............99.73 cu. ft.
1 Pfund..............1.10232 lb.
1 Ton..................2135.8 lbs.

Hanover.

1 Fuss................11.5 inches
1 Morgen ....0.6476 acre

Hindostan.

1 Borrel.................1.211 in.
1 Gerah ....2.387 ins.
1 Haut.................19.08 "
1 Kobe................29.065 "
1 Coss..................3.65 miles
1 Tuda..............1.184 cu. ft.
1 Candy...........14.209 " "

Hungary.

1 Fuss...............12.445 ins.
1 Elle....................30.67 "
1 Meile..................8297 yds
1 Oka..................3.0817 lbs.
1 Oka (liquid)....2.5 pints

Indian Empire.

1 Ady, Malabar....10.46 ins.
1 Guz..................27.125 "
1 Yard, Benares........33 "
1 Cowrie .... 1 sq. yd.
1 Sen (cubic) 61.0254 cu. in.
1 " (avoir.)....2.204737 lbs.
See separate provinces.

Italy.*

The metric system is in use, the Italian names of which are: Metra, Ara, Litro, Gramma, Stero, Tonelata de Mare.

Naples and Sicily.

1 Palmo..............10 381 ins.
1 Canna ....6.921 ft.
1 Miglio............1.1506 mile
1 Migliago.........0.7467 acre
1 Moggia...............0.86 "
1 Pezza, Roman..0.6529 "

Roman States.

Old Measure.
1 Palmo................8.347 ins.
1 Foot......... ....11.592 "
1 Foot, Architects' 11.73 ins.
1 Braccio..............30.73 "
1 Miglio...............1628 yds.
1 Quarta...........1.1414 acres

Lucca and Tuscany.

1 Palmo...............11.49 ins.
1 Pie......................11 94 "
1 Braccio..............22.98 "
1 Passetto..............3.829 ft.
1 Passo ....5.74 "
1 Miglio............1.0277 mile
1 Quadrato ....0.8413 acre
1 Saccato ....1.324 "

Japan.*

1 Shi..............0.00011875 in.
1 Mo—10 Shi....0.0011875 "
1 Rin—10 Mo.....0.011875 "
1 Bu—10 Rin ......0.11875 "
1 Sun—10 Bu........1.1875 "
1 Ki—10 Sun ......11.875 ins.
1 Kiyoka-shaku† 11.875 "
1 Kujira-shaku‡ 14.84375 ins
1 Ken—6 Ki....5 ft. 11¼ "
1 Go—10 Ki.....9 ft. 10¾ "
1 Cho.................1.06⅔ mile
1 Ri (marine).....1.1507 "
1 Ri (long meas.) 2.4403 ms.
1 Tsubo (sq.)..3.9538 sq. yds.
1 Tan (sq.).........0.2451 acre
1 Cho (sq.)........2.4507 acres
1 Ri (sq.)..........5.9552 "
1 Shi (avoir)......0.005833 gr.
1 Mo, 10 Shi " ...0.058333 "
1 Rin, 10 Mo " ...0.58333 "
1 Fun, 10 Rin " ..5.8333 grs.
1 Momme " ....58⅓ "
1 Kin or Catty " ......1⅓ lb.
1 Kwan (avoir.) 8.28171 lbs.
1 Picul " ......130 "
1 Sai (liquid)....0.012706 gill
1 Shaku " ...... 0.12706 "
1 Go, 10 Shaku (liquid)... ....1.2706 gill
1 Sho, 10 Go (liq.) 1.5881 qt.
1 To, 10 Sho (liq.) 3,9703 gal.
1 Koku, 10 To (liquid)..... ....39.7033 gals.
1 Sai (dry).....0.003229136 pt.
1 Shaku, 10 Sai (dry) .... 0.03229136 pt.
1 Go, 10 Shaku (dry measure)............. 0.3229136 pt.
1 Sho, 10 Go (dry measure)...............1.614568 qt.
1 To, 10 Sho (dry measure)............2.01821 pecks
1 Koku, 10 To (dry measure)...........5.045525 bush.

Java.

1 Duim... ....1.3 in.
1 Ell... ....27.08 ins.
1 Djong..............1.015 acres
1 Catty....................1.356 lb.
1 Tael................593.6 grains
1 Sach.................61.034 lbs.
1 Pecul..............122.068 "
1 Pecul (Batavia)..135.1 "
1 Foot " 12.357 ins.
1 Covid " 27 "
1 El " 27.75 "

*Also Metric System. † Used for measuring land. ‡ For measuring cloth.

Mexican Weights and Measures.

MARINERS' MEASURE.—The Braza (used for making soundings) = 2 varas of burgos, = 1.6718 metre. 2,220 varas of burgos = 1 marine mile; 3 marine miles (or 6,660 varas of burgos) = 1 marine league.

Mexican Land or Square Measure.		Equivalents Metric.	Equivalents English Square Measure.
1 Square vara........	....	= 0.702244 sq metr	= 1,089. sqr. inches
1-12 Caballeria or 276x184 varas.....	= 1 Fanega legal de sembradura de maiz...........	= 3.5663 hectares.	= 8.813 acres.
1104x552 varas......	= 1 Caballeria de tierra..........	= 42.7953 "	= 105.75 "
1,200 Varas square..	= 1 Fundo legal para pueblos...	= 101.223136 "	= 249.9 "
½ Legua square....	= 1 Criadero de ganado menor.....	= 195.06 7-9 "	= 482. "
¼ " "	= 1 Criadero de ganado mayor....	= 438.9025 "	= 1084.5 "
⅔ " "	= 1 Sitio de ganado menor..........	= 780.27 1-9 "	= 2928. "
1 " "	= 1 Sitio de ganado mayor..........	=1755 61 "	= 4338. "

NOTE.—The fanega of land was divided into *almudes* and *cuarterones*, as the fanega of grain was divided (see dry measures below). The fanega *rural* was twice the fanega *legal*.

MEXICAN (OLD) DRY MEASURE.		Equivalents Metric.	Eng. Dry Measure.
1-16 Almud	= 1 Copa...........	= 0.472994 litre	= ....0.833 pint....
⅛ "	= 1 Cuartilla (id. id)	= 0.945988 "	= ....0.833 quart...
¼ "	= 1 Cuarteron......	= 1.891977 "	= ....1.665 " ...
1-12 Fanega.........	= 1 Al'd or celemin	= 7.567907 litres	= ....0.833 peck....
7,200 Cubic pulgadas	= 1 Fanega.........	= 90.814888 "	= ....2.498 bushels
14,400 " "	= 1 Carga..........	= 181.629775 "	= ....4.996 "

MEXICAN (OLD) OIL MEASURE.		Equivalents Metric.	English Liquid Measure.
¼ Cuartillo	= Panilla	= 0.12654 litre	= 0.89 .... gill.....
½ "	= 1 Libra-mensural	= 0.506162 "	= 0.89 .... pint....
25 Cuartillos	= 1 Arroba-mensu'l	= 12.65405 litres	= 2.785.... gallons.

MEXICAN LIQUID MEASURE. (Excepting Oil.)		Equivalents Metric.	English Liquid Measure.
½ Cuartillo	= 1 Medio cuartillo	= 0.22815 litre	= 1.61 .... gill.....
2 Medio cuartillos.	= 1 Cuartillo.......	= 0.4563 "	= 0.805.... pint....
2 Cuartillos	= 1 Azumbre.......	= 1.825 "	= 1.61 .... quart...
8 "	= 1 Galon	= 3.65 litres	= 0.805.... gallon..

NOTE.—The *cántara* was given as 1 *arroba* of 32 *cuartillos*. The *botija* or *jarra* was given as 20 *cuartillos*; it was also given (in some districts) as 18 *cuartillos*, or one-ninth part of the *barril medido*, of 162 *cuartillos*. Various smaller *barriles* were also given, down to 140 *cuartillos*. The *castañal* was ¼ of a *barril*. The name *cuarterota* suggests ¼ of a *tonelada* weight.

Mexican (old) Running Water Measure.		Equivalents Metric.	English Cubic Measure.
1-9 Dedo	= 1 Paja......	= 0.015 litre per sec.	= 0.00053 cubic ft. per sec.
½ Real.........	= 1 Dedo. ...	= 0.135 " "	= 0.00478 " " "
⅛ Naranja......	= 1 Real	= 0.27⅔ " "	= 0.00956 " " "
⅓ Surco........	= 1 Naranja..	= 2.161 litres "	= 0.0765 " " "
1-48 Buey.	= 1 Surco	= 6.5 " "	= 0.23 " " "
* 1 Square vara.	= 1 Buey.....	= 312. " "	= 11.02 cubic feet "

* 1 Square vara = 33 x 33 ins. = 1.089 square ins. A fall of 1 pulgada to every 5 varas box running full, but no head was required.

The following table gives the principle old weights based on the *libra*,=460.24634 grammes. The *ca·ga*, was sometimes taken as 14, and at other times as 16 *arrobas*, in weighing metals.

MEXICAN WEIGHTS, with Relative Equivalents.		Equivalents. Metric.	Equivalents. Avoirdupois.
1-36 Adarme....	=1 Grano....	= 0.04994 gramme	= 0.77 grain.
1-48 Onza......	=1 Tomin	= 0.5993 "	= 9.26 grains.
1-16 Onza.......	=1 Adarme	= 1.7978 "	= 27.8 grains.
1-8 Onza.......	=1 Ochava or dracma.	= 3.5957 gra'mes	= 55.6 grains.
1-16 Libra......	=1 Onza..............	= 28.765 "	= 1.0150 ounce.
1-2 Libra......	=1 Marco....	= 230.123 "	= 0.5075 pound.
1 Libra	=2 Marcos............	= 460.246 "	= 1.0150 pound.
25 Libras.....	=1 Arroba..............	= 11,506.00 "	= 25.4 pounds.
100 Libras.....	=1 Quintal...........	= 46,025.00 "	=101.5 pounds.
12 Arrobas.....	=1 Carga (most goods)	= 138,074.00 "	=304.4 pounds.
2000 Libras.....	=1 Tonelada de mar...	= 920,493.00 "	= 0.906 ton.

The unit of long measure was the "Mexican *vara*," ¼ of 1 per cent. longer than the "vara of Burgos." The "Mexican vara," as fixed by law now,=838 millimeters.

MEXICAN LINEAR OR LONG MEASURE.		Equivalents. Metric.	Equivalents. Eng. Long Measure.
1-12 Linea.........	=1 Punto	= 0.00016 metre	= 0.0064 inch.
1-12 Pulgada.	=1 Linea	= 0.00194 "	= 0.0763 "
1-48 Vara..........	=1 Dedo............	= 0.017458 "	= 0.687 "
1-12 Pié	=1 Pulgada..	= 0.0232 7-9 "	= 0.916 "
1-4 Vara..........	=1 Palmo	= 0.2095 "	= 8.25 inches.
1-3 Vara..........	=1 Pié.	= 0.279 1-3 "	= 11.00 "
1 Vara..........	=3 Piés	= 0.838 "	= 33.00 "
50 Varas....	=1 Cordel..........	= 41.9 metres	= 137.5 feet.
5000 Varas..........	=1 Legua	= 4190. metres	= 2.60 miles.

Madras, India.

1 Ady (l. meas.)...10.46 ins.
1 Covid (l. meas.) 18.6 "
1 Guz (long meas.)..33 "
1 Culy " " 20.92 ft.
1 League " " 3472 yds.
1 Tola (avoir. wt.) 180 grs.
1 Seer " " .625 lb.
1 Viss " " 3.086 lbs.
1 Maund " " 24.686 "
1 Candy " " 500 "
1 Puddy (liquid) 0.338 gal.
1 Marcal " 2.704 gals.

Malacca.

1 Hasta or Covid, 18.125 ins.
1 Depa..................... 6 ft.
1 Orlong.............. 80 yds.

Malta.

1 Palmo........ 10.3125 ins.
1 Pie............... 11.167 "
1 Canna.............. 82.5 "
1 Salma.......... 4.44 acres

Miscellaneous.

1 Centner, Darmstadt... .... 110.24 lbs.
1 Centner, Zollverein.... .... 110.24 lbs.
1 Centner, Nuremberg... .... 112.43 lbs.
1 Centner, Brunswick.... .... 117.5 lbs.
1 Centner, Vienna......... .... 123.5 lbs.
1 Centner, Bremen....... .... 127.5 lbs.
1 Jachtan, Guinea.. 12 ft.
1 Last, England........... .... 82.52 bush.
1 Livre, Guiana....1.0791 lb.
1 Picul, Borneo..135.64 lbs.
1 Picul, Celebes, 135.64 lbs.
1 Picul of hemp, Manilla .... 139.45 lbs.
1 Picul of sugar, Manilla .... 140 lbs.
1 Quarter, Eng. 8.252 bush.
1 Vara, Curacoa, 33.375 in.

Moldavia, Roumania.

1 Foot.................... 8 ins.
1 Kot (silk)...... 24.86 ins.
1 Fathom................. 8 ft.

Molucca Islands.

1 Covid............ 18¾ ins.

Morocco.

1 Tomin....... 2.81025 ins.
1 Cadee.......... 20.34 "
1 Cubit .... 21 "
1 Rotal or Artal... 1.12 lb.
1 Muhd....... 3.08135 gals.
1 Kula (oil).... 3.356 "

Liquids other than oil are sold by weight.

Mysore, India.

1 Angle............ 2.12 ins.
1 Haut............... 19.1 "
1 Guz................ 38.2 "
1 Candy.............. 500 lbs.

Netherlands.†

1 Elle.......1 French meter

Persia.

1 Gereh........... 2.375 ins.
1 Gueza, common ...25 "
1 " Moukelrer, 37.5 "
1 Archin, Schah, 31.55 "
1 " Arish... 38.27 "
1 Parasang....... 6076 yds.
1 Chenica... 80.26 cu. ins.
1 Miscal............... 71 grs.
1 Ratel........... 2.1136 lbs.
1 Batman, Maund, 6.49 "
1 Maund........... 27.32 "
1 Artaba........ 1.809 bush.

Liquids are measured by weight.

Poland.

1 Trewice......... 14.03 ins.
1 Precikow........... 17 "
1 Pretow....... 4.7245 yds.
1 Mile (short).... 6075 "
1 Morgen...... 1.3843 acre

Portugal and Mozambique.†

1 Foot.................. 13 ins.
1 Milha.......... 1.2788 mile
1 Arratel or Libra 1.011 lb.
1 Arroba.......... 32.38 lbs.
1 Almude....... 4.422 gals.
1 Fanga........ 1.488 bush.
1 Alguieri .... 3.6 "

Prussia.

1 Fuss........... 12.358 ins.
1 Ruthe......... 4.1192 yds.
1 Meile............ 24,000 ft.
1 Quadrat Fuss............ .... 1.0603 sq. ft.
1 Morgen...... 0.63103 acre
1 Cube Fuss... 1.092 cu. ft.
1 Pound............ 7217 grs.
1 Zollpfund..... 1.1023 lb.
1 Centner....... 113.44 lbs.
1 Anker.......... 7.559 gals.
1 Scheffel..... 1.5121 bush.
1 Last.......... 112.29 "

†Also use the Metric System.

Russian Weights and Measures.

WEIGHTS.

Names of Weights.			Equivalents.	
96 Dolei		= 1 Solatnikou	= 2.408 Drams,	Avordupois.
3 Solatnik.		= 1 Latou.....	= 0.451 Ounce,	"
96 Solatnikof	= 32 Lotam	= 1 Pound	= 0.903 Pound,	"
1,280 Latof	= 40 Pounds	= 1 Pudou	= 36.120 Pounds,	"
400 Pounds	= 10 Pud	= 1 Berkovetsou.	= 3.612 Quintals = 361.2 lbs.	"

DRY MEASURE.

Names of Measures.			Equivalents in Eng. Dry Measure.
30 Chast =	1 Garnets	= ⅛ Chetverika.	= 2.887 quarts.
8 Garnets =	1 Chetverik	= ¼ Osmini..	= 2 pecks 7.1 quarts.
32 Garnets =	4 Chetverik	= 1 Osmina..	= 2 bushels, 3 pecks, 4.4 quarts.
8 Chetverik =	2 Osmina	= 1 Chetvert.	= 5 bushels, 3 pecks, 0.8 quart.
24 Osmina =	12 Chetvert	= 1 Last......	= 8 quarters, 5 bus., 1.184 pk., or 69.3 bus.

APOTHECARIES' WEIGHT.

Medical Divisions.	Equivalents in Troy Weight.
1 Salotnik =1-84 Pound...............	= 68.57142 (*repetend*) grains, troy.
7 Salotnikof=1-12 Pound.........	= 1 ounce = 480 grains, troy.
84 Salotnika =1 Pound............ ...	= 1 pound = 5,760 grains, troy.

LINEAR OR LONG MEASURE.

Note.—Since 1831, the English foot of 12 inches, each inch of ten parts, has been used as the ordinary standard of length measures.

Measures of Length.			Equivalents in Long Measure.
1 Skroople	=	1 line....	= 0.01 inch.
10 Skrooplof	=	1 Linia = 1 line........	= 0.10 inch.
10 Linii	=	1 Duim = 1-12 foot.....	= 1. inch.
1¾ Duima	=	1 Vershok..............	= 1.750 inch.
12 Duimof	=	1 Foot..................	= 12 inches = 1 foot.
7 Footof	=	3 Arshine = 1 Sajen...	= 7 feet = 1.167 fathom.
1 Arshine	=	16 Verstak = 28 Duim...	= 28 ins. = 2⅓ feet = .778 yard.
1 Versta	=	500 Sajen = 3,501 Feet	= 0.663 mile = 212.160 furlo'gs = 3501 ft.

SQUARE OR SURFACE MEASURE.

Square Measure.	English Equivalents.
144 Square Duim = 1 sqr. foot....	= 1 Square foot.
9 Square feet =1,296 sqr. Duim......	= 1 Square yard.
1 Square Arshine = 256 Sq. Vershkoff.	= 0.605 Square yard.
49 Sq. ft. = 9 sq. Arshine = 1 sq. Sajen.	= 49 Square feet = 5 sqr. yds. 4 sqr. ft.
2,400 Square Sajen = 1 square Desiatina.	= 432 Sqr. rods = 2.45 sqr. Acres.
80 x 30 sqr. Sajen = 1 Russian Acre....	= 2.45 sqr. Acres.

CUBIC OR SOLID MEASURE.

Cubic Measure.	English Equivalents.
1 Cubic foot = 1,728 Cubic Duim	= 1 cubic foot = 1,728 cubic inches.
1 Cubic Arshine = 4,096 Cubic Vershok..	= 12.704 cubic feet.
1 Cubic Sajen = 343 Cubic Feet......	= 2.68 cords = 343 cubic feet.

LIQUID MEASURE.

Measures for Liquids.	Equivalents in U. S. Liquid Measure.
1 Krushka = 10 Charok.........	= 2.166 pints.
1 Vedro = 8 Shtoff = 10 Krushka....	= 10.828 quarts = 2.707 gallons.
1 Botchka = 40 Veder.........	= 0.859 pipe = 1.718 hogshead.
1 Chetverik contains..........	64 lbs. of pure water.
1 Vedro "	30 " " " "

Siam.

1 K'up..................9.75 ins.
1 Covid....................18 "
1 Ken.......................39 "
1 Jod..............0.09848 mile
1 Boëneng.........2.462 miles
1 Catty.................. 1.35 lb.

Silesia.

1 Fuss..................11.19 ins.
1 Ruthe..............4.7238 yds.
1 Meile..................7086 "
1 Morgen...........1.3825 acre

Singapore.

1 Hasta or Cubit......18 ins.
1 Dessa........................6 ft.
1 Orlong..................80 yds.

Smyrna.

1 Pic ....26.48 ins.
1 Indise..............24.648 "
1 Berri..................1828 yds.

Spain, Cuba, Malaga, Manilla, Guatamala and Honduras †

1 Pie................. 11.128 ins.
1 Vara............... 33.384 "
1 Milla............... 0.865 mile
1 Legua, 8,000 Varas........ ....4.2151 miles
1 Fanegado.........1.6374 acre
1 Vara, cubo...21.531 cu. ft.
1 Libra, 7100 grs...1.0144 lb.
1 arroba...............25.36 lbs.
1 Quintal, Castile ....101.61 lbs.
1 Tonelado ....2028.2 "
1 Cuartilla...........0.888 gal.
1 Arroba, Castile 3.554 gals.
1 Arroba, wine.....4.26 "
1 Fanega.........1.5077 bush.

Stettin, Prussia

1 Fuss........ ....11.12 ins.
1 Foot, Rhineland.......... ....12.357 ins.
1 Elle.....................25.6 "
1 Morgen...........1.5729 acre

Sumatra.

1 Jankal, or span......9 ins.
1 Elle........ ....18 "
1 Hailoh... .... 3 feet
1 Fathom ....6 "
1 Tung ....4 yds.
1 Catty..................2.12 lbs.

Surat, India.

1 Tussoo, cloth......1.161 in.
1 Guz, cloth........27.864 ins.
1 Covid..................18.5 "
1 Hath......... .... 20.9 "
1 Biggah......... .....0.51 acre

Sweden *

1 Fot.................11.6928 ins.
1 Faden........... .....5.845 ft.
1 Ref................32.4703 yds.
1 League.........3.3564 miles
1 Mil...............6.6417 "
1 Tunnuland.....1.2198 acre
1 Centner............112.05 lbs
1 Anker..............8.641 gals.
1 Spann............1.962 bush.

Switzerland.*

1 Fuss, Berne...... 11.52 ins.
1 Fuss..................11.54 "
1 Vaud.................11.81 "
1 Klafter...................5.77 ft.
1 Meile............4.8568 miles
1 Juchart, Berne...0.85 acre
1 Pfund................1.1023 lb.
1 Mass................2.6412 pts.
1 Eimer..............8.918 gals.
1 Malter...........4.1268 bush.

Tripoli.

1 Pik, 3 Palmi......26.42 ins.
1 Almud.........319.4 cu. "
1 Killow..........2023 " "
1 Rottol..................7680 grs.
1 Oke...................2.8286 lbs.
1 Barile............ 14.267 gals.
1 Temer...........0.7383 bush.

Turkey.

1 Pik, small........... 27.9 ins.
1 " large...........27.06 "
1 Berri................. 1.828 yd.
1 Oka (avoir.)....2.82838 lbs.
1 Cantar...........124.7036 "
1 Alma.................1.154 gal.

Wurtemberg.

1 Fuss.................11.812 ins.
1 Elle ....2.015 ft.
1 Meile ....8146.25 yds.
1 Morgen ....0.7793 acre
1 Cube Fuss...0.83045 cu. ft.
1 Pound................7217 grs.
1 Eimer..............64721 gals.
1 Scheffel......... 4.878 bush.

Zurich.

1 Fuss.................11.812 ins.
1 Elle..... ....23.625 "
1 Klafter ....5.9062 ft.
1 Meile ....4.8568 miles
1 Jachart............0.808 acre
1 Cube Klafter....144 cu. ft.

* Also Metric System.

Metric Weights and Measures Converted into English.

Metres into Yards,		Litres into Gallons and Quarts.			Hectolitres into Quarts and Bushels.			Kilogrammes into Cwts. Qrs. Lbs. Oz.					Hectares into Acres. *. †.			
1=	1.094	1=	0	0.880	1=	0	2.751	1=	0	0	2	3¼	1=	2	1	35
2=	2 187	2=	0	1.761	2=	0	5.502	2=	0	0	4	6½	2=	4	3	31
3=	3.281	3=	0	2.641	3=	1	0 254	3=	0	0	6	9¾	3=	7	1	26
4=	4.374	4=	0	3.521	4=	1	3.005	4=	0	0	8	13	4=	9	3	22
5=	5.468	5=	1	0.402	5=	1	5.756	5=	0	0	11	0¼	5=	12	1	17
6=	6.562	6=	1	1.282	6=	2	0.507	6=	0	0	13	3½	6=	14	3	12
7=	7.655	7=	1	2.163	7=	2	3.258	7=	0	0	15	7	7=	17	1	8
8=	8.749	8=	1	3.043	8=	2	6.010	8=	0	0	17	10¼	8=	19	3	3
9=	9.843	9=	1	3.923	9=	3	0 761	9=	0	0	19	13½	9=	22	0	38
10=	10.936	10=	2	0 804	10=	3	3.512	10=	0	0	22	0¾	10=	24	2	34
20=	21.873	20=	4	1.608	20=	6	7.024	20=	0	1	19	1½	20=	49	1	28
30=	32.809	30=	6	2.412	30=	10	2.536	30=	0	2	16	2¼	30=	74	0	21
40=	43.745	40=	8	3.215	40=	13	6.048	40=	0	3	13	3	40=	98	3	15
50=	54 682	50=	11	0.019	50=	17	1.560	50=	1	0	10	3¾	50=	123	2	9
60=	65.618	60=	13	0.823	60=	20	5.072	60=	1	1	7	4½	60=	148	1	3
70=	76.554	70=	15	1.627	70=	24	0.585	70=	1	2	4	5¼	70=	172	3	37
80=	87.491	80=	17	2.431	80=	27	4 097	80=	1	3	1	6	80=	197	2	38
90=	98.427	90=	19	3.235	90=	30	7.609	90=	1	3	23	6¾	90=	222	1	24
100=	109 363	100=	22	0.039	100=	34	3.121	100=	2	0	20	7½	100=	247	0	18
200=	218.727	200=	44	0.077	200=	68	6.242	200=	4	1	15	15	200=	494	0	37
300=	328.090	300=	66	0.116	300=	103	1.362	300=	6	2	11	6½	300=	741	1	15
400=	437.453	400=	88	0.155	400=	137	4.483	400=	8	3	6	14	400=	988	1	33
500=	546 816	500=	10	0 1931	500=	171	7.604	500=	11	1	2	5½	500=	1235	2	11

NOTE.—The United States unit of length is the same as the English unit; so also are our lb. avoirdupois and lb. Troy identical with the English, but our gallon is different; it contains 231 cubic inches, while the imperial gallon of England contains 277.274 cubic inches. To reduce English gallons, quarts, or pints, to the United States standards, multiply by 1.20024, and to reduce English bushels to United States bushels, multiply by 1.0313644. * Roods. † Perches.

Supplemental List of Foreign Weights and Measures.

Argentine.

1 Frasco.....2.5096 quarts
1 Libra (pound).1.0127 lbs.

Austria-Hungary.

1 Joch..........1.422 acres

Belgium and Holland

1 Last.......85.134 bushels

Bremen and Brunswick.

1 Centner........117.5 lbs.

British (*England*).

Crot (hundred weight)... ....112 lbs.
1 Last......(dry malt).... .... 82.52 bushels
1 Load (timber) square, 50 cubic ft.; unhewn, 40 cubic ft.; inch planks, 600 superficial feet.
1 Quarter....8.252 bushels
1 Quarter (coal)...36 bush.
1 Stone.............14 lbs.

Bolivia.

1 Marc. ....0.507 lb.

Borneo and Celebes.

1 Pecul..........135.64 lbs.

***Castile.**

1 Quintal........101.41 lbs.

Central America.

1 Centaro....4.2631 gallons
1 Fanega.....1.5745 bushel

Chile.

1 Fanega....4.5745 bushels
1 Quintal........101.41 lbs.

China.

1 Catty............$1\frac{1}{3}$ lbs.
1 Li...............2,115 feet
1 Picul...........$133\frac{1}{3}$ lbs.

Cuba.

1 Arroba (liquid).4.263 gal.
1 Fanega......1.599 bushel

Costa Rica.

1 Manzana .....1 5/6 acre

Curacao.

1 Vara..... .33.375 inches

Denmark.

1 Centner...110.11 pounds
1 Tondeland.....1.36 acre

Germany.

1 Last....... 4,480 pounds

Greece.

1 Drachme....Half-ounce
1 Quintal....123.2 pounds

Guiana.

1 Livre (pound), 1.0791 lb.

India.

1 Bongkal ......832 grains
1 Candy (Bombay), 529 lbs.
1 " (Madras). 5(0 "
1 Maund (Bengal), $82\frac{2}{7}$ "
1 Seer .....1 lb. 13 ounces

Honduras.

1 Milla.........1.1493 mile

Isle of Jersey.

1 Vergees....71.1 sq. rods

Japan.

1 Catty (or "kin"), 1.31 lb.
1 Se............0.02451 acre
1 Tsubo......6 feet square

Java and Malacca.

1 Catty.............1.35 lb.

Luxemburg.

1 Fuder........264.17 gals.

Malta.

1 Barrel (customs)........ ....11.4 gallons
1 Caffiso.......5.4 "
1 Cantaro (cantar), 175 lbs.
1 Salm.............490 "

Mexico.

1 Carga............300 lbs.
1 Fanega (New)........... ....1.54728 bushel
1 Frasco.........2.5 quarts
1 Libra (lbs.)....1.01465 lb.
1 Quintal........101.41 lbs.

Morocco.

1 Cantar...........113 lbs.
1 Faneuga..strike=70 lbs. full=118 lbs

Nicaragua.

1 Manzana......1.727 acre
1 Milla...........1.1493 mile

Newfoundland.

1 Quintal...(fish)..112 lbs.

Norway.

1 Centner.......110.11 lbs.

Nuremberg.

1 Centner.......112.43 lbs.

Palestine.

1 Rottle..............6 lbs.

Paraguay.

1 Arobe.............25 lbs.
1 Cuadra........78.9 yards
1 " (square)..8.077 sq. ft.

1 League (land), 4,633 acres
1 Quintal..........100 lbs.
1 Vara..........34 inches

Peru.

1 Quintal........101.41 lbs.

Philippine Islands.

1 Picul...........137.9 lbs.

Portugal.

1 Almude....4.422 gallons
1 Arratal or libra. 1.011 lb.
1 Arroba.........32.38 lbs.

Poland (Russian).

1 Garnice .....0.88 gallon
1 Last........$11\frac{3}{8}$ bushels

Russia.

1 Berkovets... .361.12 lbs.
1 Chetvert .5.7748 bushels
1 Funt...........0.9028 lb.
1 Klafter....216 cubic feet
1 Pood (pud)....36.112 lbs.
1 Sagene (sajen) ....7 feet

Sarawak.

1 Coyan ... .3,098 lbs.

Spain.

1 Arroba......4.263 gallons
1 Barrel (raisins)..100 lbs.
1 Butt (wine)..140 gallons
1 Dessiatine...1.599 bushel
1 Fanega (liquid), 16 gal's
1 Frail of raisins.. 50 lbs.
1 Last (salt)......4,760 "
1 Vara.......0.914117 yard

Siam (Koyan).

1 Catty.............135 lbs.
1 Coyan .... 2,667 "

Sweden.

1 Tunna.......4.5 bushels

Syria (Damascus).

1 Cantar.......... 575 lbs.
1 Pund.. ....1.102 "
1 Quintal ....125 "
1 Rottle ....$5\frac{3}{4}$ "

Uruguay.

1 Cuadra...nearly 2 acres
1 Fanega (single)......... ....3.888 bushels
1 Libra (pound).1.0143 lb
1 Suerte........5,399 acres

Venezuela.

1 Arroba (dry), 25.4024 lbs.
1 " (liquid), 4.263 gal's
1 Fanega (dry), 1.599 bush.

Zanzibar.

1 Frasila............35 lbs.

Zollverein.

1 Centner.......110.24 lbs.

*Although the metric weights are used officially in Spain, the Castile quintal is employed in commerce in the Peninsula and colonies, save in Catalonia; the Catalan quintal equals 91.71 pounds.

METRIC WEIGHTS AND MEASURES.

Metric Weights.

Milligram (1/1000 gram) equals 0.0154 grain.
Centigram (1/100 gram) equals 0.1543 grain.
Decigram (1/10 gram) equals 1.5432 grains.
Gram equals 15.432 grains.
Decagram (10 grams) equals 0.3527 ounce.
Hectogram (100 grams) equals 3.5274 ounces.
Kilogram (1,000 grams) equals 2.2046 pounds.
Myriagram (10,000 grams) equals 22 046 pounds
Quintal (100,000 grams) equals 220.46 pounds.
Millier or tonnea—ton (1,000,000 grams) equals 2,204.6 pounds.

Metric Dry Measures.

Milliliter (1/1000 liter) equals 0.061 cubic inch.
Centiliter (1/100 liter) equals 0.6102 cubic inch.
Deciliter (1/10 liter) equals 6.1022 cubic inches.
Liter equals 0.908 quart.
Decaliter (10 liters) equals 9.08 quarts.
Hectoliter (100 liters) equals 2.838 bushels.
Kiloliter (1,000 liters) equals 1.308 cubic yards.

Metric Liquid Measures.

Milliliter (1/1000 liter) equals 0.0388 fluid ounce.
Centiliter (1/100 liter) equals 0.338 fluid ounce.
Deciliter (1/10 liter) equals 0.845 gill.
Liter equals 1.0567 quarts.
Decaliter (10 liters) equals 2.6418 gallons.
Hectoliter (100 liters) equals 26.417 gallons.
Kiloliter (1,000 liters) equals 264.18 gallons.

Metric Measures of Length.

Millimeter (1/1000 meter) equals 0.0394 inch.
Centimeter (1/100 meter) equals 0.3937 inch.
Decimeter (1/10 meter) equals 3.937 inches.
Meter equals 39.37 inches.
Decameter (10 meters) equals 393.7 inches.
Hectometer (100 meters) equals 328 feet 1 inch.
Kilometer (1,000 meters) equals 0.62137 mile (3,280 feet 10 inches).
Myriameter (10,000 meters) equals 6.2137 miles.

Metric Surface Measures.

Centare (1 square meter) equals 1,550 square inches.
Are (100 square meters) equals 119.6 square yards.
Hectare (10,000 square meters) equals 2.471 acres.

The Money, Weights, and Measures of India, and the British and U. S Equivalents, are as follows:—

The pie=⅓ farthing
3 pie=1 pice=1 farthing.
4 pice, or 12 pie,=1 anna=1 penny=2 133/4800 cents.
16 annas=1 rupee=1s. 4d.=32 cents.
15 rupees=£1=$4.86 6½.

The rupee weighs 1 tola (a tola=180 grains) 0.916 fine.

The sum of 100,000 rupees is called a "lac," and of 10,000,000 a "crore," of rupees.

The maund of Bengal of 40 seers=82 2/7 pounds avoirdupois.
The maund of Bombay=28 pounds, nearly.
The maund of Madras=25 pounds, nearly.
The tola=180 grains.
The guz of Bengal=36 inches.

THE METRIC SYSTEM

OF

WEIGHTS AND MEASURES.

The system derives its name from the *metre*, which is the primary base or unit from which the other units of the system are derived.

When the system was adopted by France the metre was assumed to be the ten-millionth part of the quadrant of the meridian passing through Barcelona and Dunkirk.

The ***Metre,*** the Unit of Length, is equal to—

39.37079 inches.
3.28089916 feet.
1.093633055 yard.
.1988423737 rod.
.0049710593 furlong.
.0006213824 mile.

The ***Are,*** the Unit of Surface, is a square whose side is 10 metres, and whose surface is 100 square metres. It is equal to—

155,005.91052241 square inches.
1,076.429934183 square feet.
119.603326020 square yards.
3.953828959 square rods.
.098845723 rood.
.024711430 acre.
.000038611 square mile.

The ***Litre,*** the Unit of Capacity, is a vessel whose volume is equal to a cube whose edge is one-tenth of a metre, and whose capacity is one-thousandth of a cubic metre. It is equal to—

61.027051519365944039 cubic inches.
.035316580740373810 cubic foot.
8.453963846838572320 United States gills.
2.113490961709643080 United States pints.
1.056745480854821540 United States quart.
.264186370213705385 United States gallon.
7.043094762720856448 Imperial gills.
1.760773690680214112 Imperial pint.
.880386845340107056 Imperial quart.
.220096711335026764 Imperial gallon.
1.816264402879167936 Winchester pint.
.908132201439583968 Winchester quart.
113516525179947996 Winchester peck.
.028379131294986999 Winchester bushel.
110048355667513382 Imperial peck.
.027512088916878345 Imperial bushel.

The ***Gramme,*** the Unit of Weight, is the weight of a cube of pure water, weighed in a vacuum, each edge of which is one-hundredth of a metre. It is equal to—

15.43234874 grains.
.0321507265 ounce troy.
.0352739399 ounce avoirdupois.
.0026792272 pound troy.
.0022046212 pound avoirdupois.

The changes from the standard units are according to the decimal scale of tens.

The descending changes are designated by prefixing the Latin ordinals to the names of the standard units.

The ascending changes are designated by prefixing the Greek cardinals to the names of the standard units.

DECI, expresses the 10th part.	DECA, expresses 10 times the value.
CENTI, expresses the 100th part.	HECTO, expresses 100 times the value.
MILLI, expresses the 1,000th part.	KILO, expresses 1,000 times the value.
	MYRIA, expresses 10,000 times the value.

MEASURES OF				PROPORTIONS.
LENGTH.	SURFACE.	CAPACITY.	WEIGHT.	
Millimetre.....	....	Millilitre	Milligramme.......	1,000th part
Centimetre.....	Centiare..	Centilitre	Centigramme	100th part
Decimetre......	....	Decilitre....	Decigramme........	10th part
Metre.........	*Are......*	*Litre...........*	*Gramme..........*	*1*
Decametre......	....	Decalitre.........	Decagramme.......	10 times
Hectometre	Hectare..	Hectolitre	Hectogramme......	100 times
Kilometre......	....	Kilolitre or Stere.	Kilogramme	1,000 times
Myriametre....	....	Myrialitre	Myriagramme......	10,000 times
....	....	....	Quintal	100,000 times
....	....	....	Millier or Tonneau.	1,000,000 times

Methods of Reading.—The number 37,426.958 metres according to the English method, is read:

Thirty-seven thousand four hundred and twenty-six metres and nine hundred and fifty-eight thousandths of a metre.

In the language of the Metric System it is read:

Three myriametres, 7 kilometres, 4 hectometres, 2 decametres, 6 metres, 9 decimetres, 5 centimetres and 8 millimetres.

It is also read in a reversed direction by beginning with the lowest denomination instead of the highest.

The methods of reading in all the tables of the system are the same as those here explained.

MEASURES OF LENGTH.

10 Millimetres	=	1 Centimetre.
10 Centimetres	=	1 Decimetre.
10 Decimetres	=	1 *Metre.*
10 *Metres*	=	1 Decametre.
10 Decametres	=	1 Hectometre.
10 Hectometres	=	1 Kilometre.
10 Kilometres.	=	1 Myriametre.

MEASURES OF SURFACES.

100 Square Millimetres	=	1 Square Centimetre.
100 Square Centimetres	=	1 Square Decimetre.
100 Square Decimetres	=	1 Square Metre.
1 Square Metre	=	1 Centiare.
100 Centiares	=	1 *Are.*
100 *Ares*	=	1 Hectare.

MEASURES OF VOLUMES.

1 Cubic Centimetre	=	1 Millilitre.
10 Millilitres	=	1 Centilitre.
10 Centilitres	=	1 Decilitre.
10 Decilitres	=	1 *Litre.*
10 *Litres*	=	1 Decalitre.
10 Decalitres	=	1 Hectolitre.
10 Hectolitres	=	1 Kilolitre or Stere.
10 Kilolitres or Steres	=	1 Myrialitre.

WEIGHTS.

10 Milligrammes	=	1 Centigramme.
10 Centigrammes	=	1 Decigramme.
10 Decigrammes	=	1 *Gramme.*
10 *Grammes*	=	1 Decagramme
10 Decagrammes	=	1 Hectogramme.
10 Hectogrammes	=	1 Kilogramme.
10 Kilogrammes	=	1 Myriagramme.
10 Myriagrammes	=	1 Quintal.
10 Quintals	=	1 Millier or Tonneau.

EQUIVALENTS

OF METRIC WEIGHTS AND MEASURES IN DENOMINATIONS OF ENGLISH AND AMERICAN SYSTEMS.

Table No. 1.

Measures of Length.	Long Measure.					
	Miles.	Furlongs.	Rods.	Yards.	Feet.	Inches.
1 Millimetre	....	....	....	....	....	.0393
1 Centimetre......	....	....	....	....	....	.3937
1 Decimetre.......	....	....	....	....	....	3.9370
1 *Metre*	....	....	....	1	....	3.3707
1 Decametre	....	....	1	5	1	3.7079
1 Hectometre	....	....	19	4	2	7.079
1 Kilometre *	....	4	38	4	1	10.79
1 Myriametre	6	1	28	2	....	11.9

The Kilometre is the Unit of Itinerary measure, and is nearly ⅝ of an English mile

Table No. 2.

Measures of Surfaces.	Square Measure.					
	Acres	Roods.	Sq Rods.	Sq. Yards.	Sq. Feet.	Sq. Inches
1 Square Millimetre....	......	....	....	....	....	.0015
1 Square Centimetre...	...	....	....	....	....	.1550
1 Square Decimetre....	......	....	....	....	....	15.5005
1 Centiare or 1 Sq. Metre	......	....	....	1	1	110.0591
1 *Are*................	......	....	3	28	7	97 9105
1 Hectare *	2	1	35	11	5	35.0522
1 Sq. Kilometre †......	247	....	18	8	6	121.2241

* The Hectare is the Unit of Land measure, and is nearly 2½ English acres.
† The Square Kilometre is the Unit for the Area of countries. and is .3861161 of an English square mile.

Table No. 3.

Measures of Volumes.	Cubic Measure.		
	Cubic Yards.	Cubic Feet.	Cubic Inches.
1 Millilitre	....	....	.06102705151936
1 Centilitre	....	....	.61027051519365
1 Decilitre	....	....	6.10270515193659
1 *Litre*	....	....	61 02705151936594
1 Decalitre	....	....	610.27051519365944
1 Hectolitre	....	3	918.70515193659440
1 Kilolitre or Stere *	1	8	547.05151936594403
1 Myrialitre	13	2	286.51519365944039

* The Cubic Metre, Kilolitre or Stere, is sometimes used as the Unit of measures of Solidity.

Table No. 4.

Measures of Volumes.	Liquid Measure. (U. S. Gallon.)				Liquid Measure. (Imperial Gallon.)			
	Gallons.	Quarts	Pints.	Gills.	Gals.	Qts.	Pints.	Gills.
1 Millilitre	......	......	......	.0084	......	......	......	.0070
1 Centilitre	......	......	......	.0845	......	......	......	.0704
1 Decilitre	......	......	......	.8453	......	......	......	.7043
1 *Litre*	......	1	......	.4539	......	......	1	3.0430
1 Decalitre	2	2	1	.5396	2	......	1	2.4309
1 Hectolitre	26	1	1	1.3963	22	......	......	.3094
1 Kilolitre or Stere.	264	......	1	1.9638	220	......	......	3.0947
1 Myrialitre	2641	3	......	3.6384	2200	3	1	2.9476

Table No. 5.

Measures of Volumes.	Medical Divisions of the Gallon.				
	Gallons.	Pints.	Fluid-ounces.	Fluidrams.	Minims.
1 Millilitre	....	....	....	....	16.2316
1 Centilitre	....	....	....	2	42.3161
1 Decilitre	....	....	3	3	3.1610
1 *Litre*	....	2	1	6	31.6105
1 Decalitre	2	5	2	1	16.1058
1 Hectolitre	26	3	5	4	41.0585
1 Kilolitre	264	1	7	6	50.5859
1 Myrialitre	2641	6	14	4	25.8593

Table No. 6.

Measures of Volumes.	Dry Measure. (U. S. or Winchester Bushel.)				Dry Measure. (Imperial Bushel.)			
	Bushel.	Pecks.	Quarts	Pints.	Bush.	Pecks	Qts.	Pints.
1 Millilitre	....	....	....	.0018	......	......	......	.0017
1 Centilitre	....	....	....	.0181	......	......	......	.0176
1 Decilitre	....	....	....	.1816	......	......	......	.1760
1 *Litre*	....	....	....	1.8162	......	......	......	1.7607
1 Decalitre	....	1	1	.1626	......	1	......	1.6077
1 Hectolitre	2	3	2	1.6264	2	3	......	.0773
1 Kilolitre or Stere.	28	1	4	.2644	27	2	.....	.7736
1 Myrialitre	283	3	1	.6440	275	......	3	1.7369

Table No. 7.

Weights.	Troy Weight.				Avoirdupois Weight.			
	Pounds.	Ounces	Pwts.	Grains.	Lbs.	Ozs.	Drams.	Grains.
1 Milligramme.... ..	....	....	......	.0154	......	....	....	.0154
1 Centigramme	....	....	......	.1543	.....	....	....	.1543
1 Decigramme	....	....	......	1.5432	......	....	....	1.5432
1 *Gramme*	....	....	......	15.4323	......	....	....	15.4323
1 Decagramme	....	....	6	10.3234	......	....	5	17.6047
1 Hectogramme	....	3	4	7 2348	......	3	8	11.9848
1 Kilogramme *	2	8	3	.3487	2	3	4	10.4737
1 Myriagramme	26	9	10	3.4874	22	....	11	22.7061
1 Quintal	267	11	1	10.874	220	7	6	8.3115
1 Millier or Tonneau.	2679	2	14	12.74	2204	9	15	1.0837

* The Kilogramme is the Unit of Commercial Weight, and is 2 1-5 pounds avoirdupois.

Table No. 8.

Weights.	Apothecaries Weight.				
	Pounds.	Ounces.	Drams.	Scruples.	Grains.
1 Milligramme	....	....	....	....	.0154
1 Centigramme.	....	....	....	....	.1543
1 Decigramme	....	....	.. ..	....	1.5432
1 *Gramme*	....	....	....	....	15.4323
1 Decagramme	....	....	2	1	14.3234
1 Hectogramme	....	3	1	2	3.2348
1 Kilogramme	2	8	1	....	12.3487
1 Myriagramme	26	9	4	....	3.4874

MULTIPLIERS

TO REDUCE FROM THE DENOMINATIONS OF ONE SYSTEM TO THE OTHER.

Table No. 9.

MEASURES OF LENGTH.	LONG MEASURE.					
	MILES.	FURLONGS.	RODS.	YARDS.	FEET.	INCHES.
1 Millimetre.......	....	....	.00019	.00109	.00328	.03937
1 Centimetre	....	.00004	.00198	.01093	.03280	.3937C
1 Decimetre	.00006	.00049	.01988	.10936	.32808	3.93707
1 *Metre*	.00062	.00497	.19884	1.09363	3.28089	39.37079
1 Decametre.......	.00621	.04971	1.98842	10 93633	32.80899	393.7079
1 Hectometre......	.06213	.49710	19.88423	109.36330	328.08991	3937.079
1 Kilometre........	.62138	4.97105	198.84237	1093.63305	3280.89916	39370.79
1 Myriametre......	6.21382	49.71059	1988.42373	10936.33055	32808.99166	393707.9

Example—Reduce 523 kilometres to miles:
523×.62138=324.98 miles.

Table No. 10.

LONG MEASURE.	MEASURES OF LENGTH.			
	MYRIAMETRES.	KILOMETRES	HECTOMETRES.	DECAMETRES.
1 Inch	....	.00002	.00025	.00253
1 Foot	.00003	.00030	.00304	.03047
1 Yard..............	.00009	.00091	.00914	.09143
1 Fathom...........	.00018	.00182	.01828	.18287
1 Rod	.00050	.00502	.05029	.50291
1 Furlong...........	.02011	.20116	2.01164	20.11643
1 Statute Mile	.16093	1.60931	16.09314	160.93149
1 Nautical Mile.....	.18549	1.85494	18.54945	185.49456
1 Statute League....	.48279	4.82794	48.27944	482.79447
1 Nautical League ..	.55648	5.56483	55.64836	556.48368

LONG MEASURE.	MEASURES OF LENGTH.			
	Metres.	DECIMETRES	CENTIMETRES.	MILLIMETRES.
1 Inch	.02539	.25399	2.53995	25.39954
1 Foot	.30479	3.04794	30.47944	304.79449
1 Yard..............	.91438	9.14383	91.43834	914.38348
1 Fathom.	1.82876	18.28766	182.87669	1828.76696
1 Rod	5.02910	50.29109	502.91091	5029.10914
1 Furlong...........	201.16436	2011.64365	20116.43657	....
1 Statute Mile	1609.31492	16093.14926	....	....
1 Nautical Mile.....	1854.94562	18549.45628	....	....
1 Statute League....	4827.94477	48279.44778	....	....
1 Nautical League...	5564.83668	55648.36886	....	....

Example—Reduce 146 yards to metres:
146×.91438=133.5 metres.

Table No. 11.

MEASURES OF SURFACES.	SQUARE MEASURE.					
	ACRES.	ROODS.	SQ. RODS.	SQ. YARDS.	SQ. FEET.	SQ. INCHES
1 Sq. Millimetre...	....	....	....	....	.00001	.00155
1 Sq. Centimetre...	....	....	....	.00011	.00107	.15500
1 Sq. Decimetre ...	....	....	.00039	.01196	.10764	15.50059
1 Centiare	.00024	.00098	.03953	1.19603	10.76429	1550.05910
1 *Are*.............	.02471	.09884	3.95382	119.60332	1076.42993	....
1 Hectare..........	2.47114	9 88457	395.38289	11960.33260	....	....
1 Sq. Kilometre....	247.11430	988.45723	39538.28959	....	....	....

Example—Reduce 647 hectares to acres:

647×2.47114=1,598.82 acres.

Table No. 12.

SQUARE MEASURE.	MEASURES OF SURFACES.			
	SQUARE KILOMETRES.	HECTARES.	*Ares.*	CENTIARES.
1 Square Inch...	....	....	....	.00064
1 Square Foot...	....	....	.00092	.09289
1 Square Yard...	....	.00008	.00836	83609
1 Square Rod ...	.00002	.00252	.25291	25.29193
1 Rood	.00101	.10116	10.11677	1011.67755
1 Acre	.00404	.40467	40.46710	4046.71020
1 Square Mile...	2.58989	258.98945	25898.94531	....

SQUARE MEASURE.	MEASURES OF SURFACES.			
	SQ. METRES.	SQUARE DECIMETRES.	SQUARE CENTIMETRES.	SQUARE MILLIMETRES.
1 Square Inch...	.00064	.06451	6.45136	645.13608
1 Square Foot...	.09289	9.28996	928.99683	92899.68331
1 Square Yard...	.83609	83.60971	8360.97149	....
1 Square Rod....	25.29193	2529.19387	....	....
1 Rood	1011.67755	....	....	....
1 Acre	4046.71020	....	....	....
1 Square Mile ..	....	....	....	....

Example—Reduce 160 acres to hectares:

160×.40467=64.74.

Table No. 13.

MEASURES OF VOLUMES.	CUBIC MEASURE.			
	CORDS.	CUBIC YARDS	CUBIC FEET.	CUBIC INCHES.
1 Millilitre..........	.0000002	.0000013	.0000353	.0610270
1 Centilitre.	.0000027	.0000130	.0003531	.6102705
1 Decilitre..........	.0000275	.0001308	.0035316	6.1027051
1 *Litre*	.0002759	.0013080	.0353165	61.0270515
1 Decalitre..........	.0027591	.0130802	.3531658	610.2705151
1 Hectolitre.	.0275910	.1308021	3.5316580	6102.7051519
1 Kilolitre	.2759107	1.3080215	35.3165807	61027.0515193
1 Myrialitre	2.7591078	13.0802150	353.1658074	610270.5151936

Example—Reduce 132 kilolitres or steres to cords:
132×.2759107=36.42 cords.

Table No. 14.

CUBIC MEASURE.	MEASURES OF VOLUMES.			
	MYRIALITRES.	KILOLITRES.	HECTOLITRES.	DECALITRES.
1 Cubic Inch....	....	.00001	.00016	.00163
1 Cubic Foot....	.00283	.02831	.28315	2.83153
1 Cubic Yard	.07645	.76451	7.64513	76.45134
1 Cord	.36243	3.62435	36.24359	362.43599

CUBIC MEASURE.	MEASURES OF VOLUMES.			
	Litres.	DECILITRES.	CENTILITRES.	MILLILITRES.
1 Cubic Inch	.01638	.16386	1.63861	16.38617
1 Cubic Foot....	28.31531	283.15311	2831.53119	28315.31193
1 Cubic Yard....	764.51342	7645.13422	76451.34221	....
1 Cord	3624.35992	36243.59927	....	....

Example—Reduce 234 cords to kilolitres or steres:
234×3.62435=848.09 kilolitres or steres.

Table No. 15.

MEASURES OF VOLUMES.	LIQUID MEASURE—(U. S. Gallon.)			
	GALLONS.	QUARTS.	PINTS.	GILLS.
1 Millilitre......	.00026	.00105	.00211	.00845
1 Centilitre.....	.00264	.01056	.02113	.08453
1 Decilitre......	.02641	.10567	.21134	.84539
1 *Litre*	.26418	1.05674	2.11349	8.45396
1 Decalitre......	2.64186	10.56745	21.13490	84.53963
1 Hectolitre.....	26.41863	105.67454	211.34909	845.39638
1 Kilolitre	264.18637	1056.74548	2113.49096	845
1 Myrialitre ...	2641.86370	10567.45480	21134.90961	84539.638

Example—Reduce 548 litres to U. S. gallons:
548×.26418=144.77 U. S. gallons.

Table No. 16.

LIQUID MEASURE (U. S. Gallon.)	MEASURES OF VOLUMES.			
	MYRIALITRES.	KILOLITRES.	HECTOLITRES.	DECALITRES.
1 Gill...........	.00001	.00011	.00118	.01182
1 Pint	.00004	.00047	.00473	.04731
1 Quart..........	.00009	.00094	.00946	.09463
1 Gallon	.00037	.00378	.03785	.37852

LIQUID MEASURE (U. S. Gallon.)	MEASURES OF VOLUMES.			
	Litres.	DECILITRES.	CENTILITRES.	MILLILITRES.
1 Gill...........	.11828	1.18287	11.82877	118.28770
1 Pint...........	.47315	4.73150	47.31508	473.15082
1 Quart..........	.94630	9.46301	94.63016	946.30165
1 Gallon.........	3.78520	37.85206	378.52066	3785.20662

Example—Reduce 730 U. S. gallons to litres:
730×3.7852 = 2,763.19 litres.

Table No. 17.

MEASURES OF VOLUMES.	LIQUID MEASURE—(Imperial Gallon.)			
	GALLONS.	QUARTS.	PINTS.	GILLS.
1 Millilitre......	.00022	.00088	.00176	.00704
1 Centilitre......	.00220	.00880	.01760	.07043
1 Decilitre......	.02200	.08803	.17607	.70430
1 *Litre*	.22009	.88038	1.76077	7.04309
1 Decalitre	2.20096	8.80386	17.60773	70.43094
1 Hectolitre.. ..	22.00967	88.03868	176.07736	704.30947
1 Kilolitre......	220.09671	880.38684	1760.77369	7043.09476
1 Myrialitre.....	2200.96711	8803.86845	17607.73690	70430.94762

Example—Reduce 548 litres to Imperial gallons:
548×.22009 = 120.61 Imperial gallons.

Table No. 18.

LIQUID MEASURE (Imp. Gallon.)	MEASURES OF VOLUMES.			
	MYRIALITRES.	KILOLITRES.	HECTOLITRES.	DECALITRES.
1 Gill....	.00001	.00014	.00141	.01419
1 Pint...........	.00005	.00056	.00567	.05679
1 Quart	.00011	.00113	.01135	.11358
1 Gallon	.00045	.00454	.04543	.45434

LIQUID MEASURE (Imp. Gallon.)	MEASURES OF VOLUMES.			
	Litres.	DECALITRES.	CENTILITRES.	MILLILITRES.
1 Gill...	.14198	1.41983	14.19830	141.98303
1 Pint...........	.56793	5.67932	56.79321	567.93215
1 Quart.....	1.13586	11.35864	113.58643	1135.86431
1 Gallon	4.54345	45.43457	454.34572	4543.45725

Example—Reduce 730 Imperial gallons to litres:
730×4.54345 = 3,316.71 litres.

Table No. 19.

Measures of Volumes.	Medical Divisions of the Gallon.				
	GALLONS.	PINTS.	FLUIDOUNCES	FLUIDRAMS	MINIMS.
1 Millilitre	.00026	.00211	.03381	.27052	16.231
1 Centilitre	.00264	.02113	.33815	2.70526	162.31610
1 Decilitre.......	.02641	.21134	3.38158	27.05268	1623.16105
1 *Litre*	.26418	2.11349	33.81585	270.52684	16231.61058
1 Decalitre.......	2.64186	21.13490	338.15855	2705.26843	....
1 Hectolitre......	26.41863	211.34909	3381.58553	27052.68430	....
1 Kilolitre.......	264.18637	2113 49096	33815.85538	....	....
1 Myrialitre	2641.86370	21134.90961	....	....	....

Example—Reduce 7 litres to fluidounces:
7×33.81585=236.71 fluidounces.

Table No. 20.

Medical Div of the Gallon.	Measures of Volumes.			
	MYRIALITRES.	KILOLITRES.	HECTOLITRES.	DECALITRES.
1 Minim	....	....	....	....
1 Fluidram	....	....	.00003	.00036
1 Fluidounce....	....	.00002	.00029	.00295
1 Pint	.00004	.00047	.00473	.04731
1 Gallon.......	00037	.00378	.03785	.37852

Medical Div. of the Gallon.	Measures of Volumes.			
	Litres.	DECILITRES.	CENTILITRES.	MILLILITRES.
1 Minim	.00006	.00061	.00616	.06160
1 Fluidram......	.00369	.03696	.36964	3.69649
1 Fluidounce....	.02957	.29571	2.95719	29.57192
1 Pint..........	.47315	4.73150	47.31508	473.15082
1 Gallon.	3.78520	37.85206	378.52066	3785.20662

Example—Reduce 14 fluidounces to centilitres:
14×2.95719=41.4 centilitres.

Table No. 21.

Measures of Volumes.	Dry Measure—(Winchester Bushel.)			
	BUSHELS.	PECKS.	QUARTS.	PINTS.
1 Millilitre......	.00002	.00011	.00090	.00181
1 Centilitre.....	.00028	.00113	.00908	.01816
1 Decilitre......	.00283	.01135	.09081	.18162
1 *Litre*	.02837	.11351	.90813	1.81626
1 Decalitre......	.28379	1.13516	9.08132	18.16264
1 Hectolitre.....	2.83791	11.35165	90.81322	181.62644
1 Kilolitre	28 37913	113.51652	908.13220	1816.26440
1 Myrialitre....	283.79131	1135.16525	9081.32201	18162.64402

Example—Reduce 631 hectolitres to Winchester bushels:
631×2.83791=1.790.72 Winchester bushels.

Table No. 22.

DRY MEASURE. (Winch. Bushel.)	MEASURES OF VOLUMES.			
	MYRIALITRES.	KILOLITRES.	HECTOLITRES.	DECALITRES.
1 Pint........	.00005	.00055	.00550	.05505
1 Quart.........	.00011	.00110	.01101	.11011
1 Peck..........	.00088	.00880	.08809	.88092
1 Bushel........	.00352	.03523	.35237	3.52371

DRY MEASURE. (Winch. Bushel.)	MEASURES OF VOLUMES.			
	Litres.	DECILITRES.	CENTILITRES.	MILLILITRES.
1 Pint..........	.55058	5.50580	55.05806	550.58063
1 Quart.........	1.10116	11.01161	110.11612	1101.16126
1 Peck.........	8.80929	88.09290	880.92900	8809.29008
1 Bushel........	35.23716	352.37160	3523.71603	35237.16034

Example—Reduce 123 Winchester bushels to litres:
$123 \times 35.23716 = 4{,}334.17$ litres.

Table No. 23.

MEASURES OF VOLUMES.	DRY MEASURE—(Imperial Bushel.)			
	BUSHELS.	PECKS.	QUARTS.	PINTS.
1 Millilitre......	.00002	.00011	.00088	.00176
1 Centilitre.....	.00027	.00110	.00880	.01760
1 Decilitre......	.00275	.01100	.08803	.17607
1 *Litre*.........	.02751	.11004	.88038	1.76077
1 Decalitre	.27512	1.10048	8.80386	17.60773
1 Hectolitre.....	2.75120	11.00483	88.03868	176.07736
1 Kilolitre	27.51208	110.04835	880.38684	1760.77369
1 Myrialitre....	275.12088	1100.48355	8803.86845	17607.73690

Example—Reduce 631 hectolitres to Imperial bushels:
$631 \times 2.7512 = 1{,}736$ Imperial bushels.

Table No. 24.

DRY MEASURE. (Imperial Bushel.)	MEASURES OF VOLUMES.			
	MYRIALITRES.	KILOLITRES.	HECTOLITRES.	DECALITRES.
Pints............	.00005	.00056	.00567	.05679
Quarts..........	.00011	.00113	.01135	.11358
Pecks...........	.00090	.00908	.09086	.90869
Bushels.........	.00363	.03634	.36347	3.63476

Table No. 24—CONTINUED.

DRY MEASURE. (Imperial Busbel.)	MEASURES OF VOLUMES.			
	Litres.	DECILITRES.	CENTILITRES.	MILLILITRES.
Pints............	.56793	5.67932	56.79321	567.93215
Quarts....	1.13586	11.35864	113.58643	1135.86431
Pecks	9.08691	90.86914	908.69145	9086.91451
Bushels..	36.34765	363.47658	3634.76580	36347.65804

Example—Reduce 123 Imperial bushels to litres:
123×36 34765=4470.76 litres.

Table No. 25.

WEIGHTS.	TROY WEIGHT.			
	POUNDS.	OUNCES.	PENNYWEIGHTS.	GRAINS.
1 Milligramme.......	....	.00003	.00064	.01543
1 Centigramme......	.00002	.00032	.00643	.15432
1 Decigramme........	.00026	.00321	.06430	1.54323
1 *Gramme*..........	.00267	.03215	.64301	15.43234
1 Decagramme.......	.02679	.32150	6.43014	154.32348
1 Hectogramme......	.26792	3.21507	64.30145	1543.23487
1 Kilogramme.	2 67922	32.15072	643.01453	15432.34874
1 Myriagramme......	26.79227	321.50726	6430.14530	....
1 Quintal	267.92272	3215.07265	64301.45308	....
1 Millier or Tonneau.	2679.22721	32150 72654	....	....

Example—Reduce 432 grammes to ounces troy:
432×.03215=13.88 ounces troy.

Table No. 26.

TROY WEIGHTS.	WEIGHTS.				
	MILLIER OR TONNEAU.	QUINTALS.	MYRIA-GRAMMES.	KILO-GRAMMES.	HECTOGRAMMES.
1 Grain........	....	....	....	.00006	.00064
1 Pennyweight.	....	.00001	.00015	.00155	.01555
1 Ounce........	.00003	.00031	.00311	.03110	.31103
1 Pound	.00037	.00373	.03732	.37324	3.73241

TROY WEIGHTS.	WEIGHTS.				
	DECA-GRAMMES.	*Grammes.*	DECI-GRAMMES.	CENTI-GRAMMES.	MILLIGRAMMES
1 Grain.... ...	.00647	.06479	.64798	6.47989	64.79895
1 Pennyweight.	.15551	1.55517	15.55174	155.51748	1555.17481
1 Ounce........	3.11034	31.10349	311.03496	3110.34963	31103.49631
1 Pound........	37.32419	373.24195	3732.41955	37324.19557	....

Example—Reduce 115 troy ounces to grammes:
115×31.10349=3,576.9 grammes.

Table No. 27.

WEIGHTS.	AVOIRDUPOIS WEIGHT.			
	POUNDS.	OUNCES.	DRAMS.	GRAINS.
1 Milligramme.........	....	.00003	.00056	.01543
1 Centigramme.	.00002	.00035	.00564	.15432
1 Decigramme........ ...	.00022	.00352	.05643	1.54323
1 *Gramme*............	.00220	.03527	.56438	15.43234
1 Decagramme	.02204	.35273	5.64383	154.32348
1 Hectogramme..........	.22046	3.52739	56.43830	1543.23487
1 Kilogramme........ ...	2.20462	35.27393	564.38303	15432.34874
1 Myriagramme	22.04621	352.73939	5643.83038	....
1 Quintal................	220.46212	3527.39399	56438.30384	....
1 Millier or Tonneau....	2204.62124	35273.93990	....	....

Example—Reduce 432 grammes to ounces avoirdupois:
432×.03527=15.23 ounces avoirdupois.

Table No. 28.

AVOIRDUPOIS WEIGHTS.	WEIGHTS.				
	MILLIER OR TONNEAU.	QUINTALS.	MYRIA-GRAMMES.	KILO-GRAMMES.	HECTO-GRAMMES.
1 Grain	....	....	....	.00006	.00064
1 Dram	....	.00001	.00017	.00177	.01771
1 Ounce...........	.00002	.00028	.00283	.02834	.28349
1 Pound............	.00045	.00453	.04535	.45359	4.53592
1 Hundred Weight..	.04535	.45359	4.53592	45.35926	453.59265
1 Ton (2,000 lbs.)...	.90718	9.07185	90.71853	907.185 0	9071.85309
1 Ton (2,240 lbs.)...	1.01604	10.16047	101.60475	1016.04754	10160.47546

AVOIRDUPOIS WEIGHTS.	WEIGHTS.				
	DECA-GRAMMES.	*Grammes*	DECI-GRAMMES.	CENTI-GRAMMES	MILLI-GRAMMES.
1 Grain.............	.00647	.06479	.64798	6.47989	64.79895
1 Dram	.17718	1.77184	17.71846	177.18463	1771.84630
1 Ounce	2.83495	28.34954	283.49540	2834.95409	28349.54090
1 Pound	45.35926	453.59265	4535.92653	45359.26545	....
1 Hundred Weight..	4535.92654	45359.26540	....	....	....
1 Ton (2,000 lbs.)...	90718.53090	....	....	....	....
1 Ton (2,240 lbs.)...	101604.75461	....	....	....	....

Example—Reduce 468 pounds avoirdupois to kilogrammes:
468×.45359=212.28 kilogrammes.

Table No. 29.

WEIGHTS.	APOTHECARIES WEIGHT.				
	POUNDS.	OUNCES.	DRAMS.	SCRUPLES.	GRAINS.
1 Milligramme...	....	.00003	.00025	.00077	.01543
1 Centigramme...	.00002	.00032	.00257	.00771	.15432
1 Decigramme....	.00026	.00321	.02572	.07716	1.54323
1 *Gramme*......	.00267	.03215	.25720	.77161	15.43234
1 Decagramme ...	.02679	.32150	2.57205	7.71617	154.32348
1 Hectogramme ..	.26792	3.21507	25.72058	77.16174	1543.23487
1 Kilogramme ...	2.67922	32.15072	257.20581	771.61743	15432 34874
1 Myriagramme ..	26.79227	321.50726	2572.05812	7716.17437	....

Example—Reduce 25 grammes to drams:
$25 \times .2572 = 6.43$ drams.

Table No. 30.

APOTHECARIES WEIGHT.	WEIGHTS.			
	MYRIAGRAMMES.	KILOGRAMMES.	HECTOGRAMMES.	DECAGRAMMES.
1 Grain.........	....	.00006	.00064	.00647
1 Scruple.......	.00012	.00129	.01295	.12959
1 Dram	.00038	.00388	.03887	.38879
1 Ounce	.00311	.03110	.31103	3.11034
1 Pound	.03732	.37324	3.73241	37.32419

APOTHECARIES WEIGHT.	WEIGHTS.			
	Grammes.	DECIGRAMMES.	CENTIGRAMMES.	MILLIGRAMMES.
1 Grain	.06479	.64798	6.47989	64.79895
1 Scruple	1.29597	12.95979	129.59790	1295.97901
1 Dram..........	3.88793	38.87937	388.79370	3887.93703
1 Ounce.	31.10349	311.03496	3110.34963	31103.49631
1 Pound	373.24195	3732.41955	37324.19557	....

Example—Reduce 2 scruples to grammes:
$2 \times 1.29597 = 2.59$ grammes.

THE GRAMME.

Different authors give the following values for the gramme in grains. The second in the list is now generally adopted:

15.432	15.432349	15.434	15.44
15.43234874	15.4327	15.43402344	15.4402
15.43234875	15.433159	15.438395	15.44242
15.4323488			15.44402

TABLE OF MERCHANDISE

Constituting a Ton by Weight or Measurement, also a Car Load.

Articles.	Size. cub. ft.	Per Ton. Weight.	Per Ton. Measur'm't	Car load, br'd gauge.
Acid, carboys, each	6.8		6 carboys	120 carboys
Beans, sacks, 60 lbs. each		34 sacks		630 sacks
Beans, sacks, gunny, 120 lbs. each		17 sacks		340 sacks
Beef and pork, bbls., each	7		6 bbls.	120 bbls.
Beef and pork, ½ bbls., each	8.6		12½ ½ bbls.	250½ bbls.
Blinds, packages, each	9		9 pkgs.	180 pkgs.
Boots and shoes, cases, each	4		10 cases	200 cases
Brick, 8x4⅛x2½ inches		393 brick	837 brick	6000 brick
Brooms, packages, each	3.5		12 pkgs.	240 pkgs.
Candles, boxes, each	.8	74 boxes	60 boxes	1200 boxes
Cattle, head of	40	1.9 head	1 head	18 to 20 hd
Cement, bbls., each	6.3	6.66 bbls.	7 bbls.	140 bbls.
Chain, casks, 500 lbs. each	8	4 casks	5 casks	80 casks
Chain, casks, 1,000 lbs. each	14	2 casks	3 casks	40 casks
Charcoal, sacks, 55 lbs. each	5.3	37 sacks	8 sacks	740 sacks
Coal, casks, 1,500 lbs each		1.33 casks		13 casks
Coal, sacks, 150 lbs. each	3.12	17 sacks	13 sacks	340 sacks
Coal (loose), 2,240 lbs., per ton		2240 lbs.	40 cu. ft.	10 tons
Coffee, sacks, 100 lbs. each		20 sacks		400 sacks
Coffee, sacks, 150 lbs. each		13 sacks		260 sacks
Coffee, cases, each	2.3		20 cases	400 cases
Copper, boxes, 600 lbs. each		4 boxes		80 boxes
Cordage, coils, small, each	1		40 cases	900 cases
Cordage, or Rope, coils, 2 each	2		20 cases	450 cases
Cordage, or Rope, coils, 3 each	6		7 cases	140 cases
Cordage, or Rope, coils, 4 each	10		4 cases	80 cases
Cordage, or Rope, coils, 5 each	15		3 cases	60 cases
Cotton, bales of, 475 lbs., each	10	4½ bales	4 bales	90 bales
Crockery, crates, small, each	20		2 crates	40 crates
Crockery, crates, large, each	40		1 crate	20 crates
Crockery, casks, small, each	20		2 casks	40 casks
Crockery, casks, large, each	40		1 cask	20 casks
Crockery, bbls., each	6.3		7 bbls.	140 bbls.
Doors			30 doors	600 doors
Excelsior, bales, each	15		3 bales	60 bales
Furniture, cases chairs, each	9		5 cases	89 cases
Flour, sacks, 100 lbs. each		20 sacks		400 sacks
Flour, sacks, 50 lbs. each		40 sacks		900 sacks
Flour, gunnies, 150 lbs. each		14 sacks		280 sacks
Flour, bbls., each	6.3	9½ bbls.	7 bbls.	90 bbls.
Flour, ½ bbls., each	3.6	19½ bbls.	14½ ½ bbls	190½ bbls.
Fruits—apples, oranges, pears, quinces, grapes, etc., in cases	2		20 cases	400 cases
Fruits, preserved, cases	1.6		27 cases	540 cases
Glass, boxes, each	1		40 boxes	800 boxes
Glass, boxes, each	1.6		27 boxes	540 boxes
Glass, boxes, each	2		20 boxes	400 boxes
Grain—Barley, burlap s'ks, 130 lbs. each		16 sacks		320 sacks
" Bran, sacks, 50 lbs. each		40 sacks		800 sacks
" Corn, ear, 70 lbs. per bushel		28½ bush.	16.77 bush.	360 bushels
" " shelled, 56 lbs. per bushel		36 bushels	32.1 bush.	720 bushels
" " sacks, 120 lbs. each		17 sacks		340 sacks
" Middlings, sacks, 80 lbs. each		25 sacks		500 sacks
" Oats, burlap sacks, 95 lbs. each		22 sacks		440 sacks
" " loose		2000 lbs.	32.1 bush.	680 bushels
" Wheat, burlap sacks, 130 lbs. ea		16 sacks		320 sacks
Gunnies, bales, each (small)	14		3 bales	60 bales
" " " (large)	20		2 bales	40 bales
Hair and Moss, bales of	15		3 bales	60 bales
Hams and Bacon, cases, each	9		5 cases	100 cases
Handles, Ax, cases, each	1.4		17 cases	340 cases
Iron, cast pipes, castings, etc		2240 lbs.		10 tons
" pig, 2,240 lbs. per ton		2240 lbs.		10 tons
" sheet, bdls., 120 lbs. each		17 bdls.		340 bdls.
Leather, rolls, each	9		5 rolls	100 rolls
Lime, bbls., each	6.3		7 bbls.	70 bbls.
Liquors, cases, each	1.6		27 cases	540 cases

TABLE OF MERCHANDISE,

By Weight and Measurement.—Concluded.

Articles.	Size. cub.ft.	Per Ton. Weight.	Per Ton. Measure.	Car-load, br'd gauge
Liquors, bbls., each	9.83		4 bbls.	80 bbls.
" ½ bbls., each	4.92		8½ ½ bbls.	170½ bbls.
" baskets, each	2.6		16 baskets	320 cases
" pipes, each	24.6		2 pipes	34 pipes
Lumber (board measure), etc			480 feet	9,000 feet
" flooring, board measure			480 feet	3,000 feet
" hard wood			⅓ cord	6 cords
" joists or plank			480 feet	9,000 feet
" shingles			1,000 sh's	40,000 sh's
" siding, board measure			850 feet	17,000 feet
" soft or cord wood			⅓ cord	7 cords
Matting, China, bales, each	5		8 bales	160 bales
Merchandise, bbls., each	6.3		7 bbls.	140 bbls.
Nails and spikes, kegs 100 lbs	1.3	20 kegs	30 kegs	400 kegs
Oakum, bales, each	3.6		12 bales	240 bales
Oils, bbls., each	12		4 bbls.	80 bbls.
" ½ bbls., each	4.93		8½ ½ bbls.	165 ½ bbls.
" casks, large, each	40		1 cask	20 casks
" " small, each	20		2 casks	40 casks
" coal, lard, nut, etc., cases	2		20 cases	400 cases
Onions, sacks, 100 lbs. each	2.7	20 sacks	15 sacks	400 sacks
Paints, cases of 100 lbs. each		20 cases		400 cases
" " of 200 lbs. each		10 cases		200 cases
" kegs of 200 lbs. each		10 kegs		200 kegs
" " of 100 lbs. each		20 kegs		400 kegs
" " of 50 lbs. each		40 kegs		800 kegs
" " of 25 lbs. each		80 kegs		1,600 kegs
" tin cases, 25 lbs. each		80 cases		1,600 cases
Papers, bales of, each	7		8 bales	150 bales
Pianos, cases, each	40		1 case	40 cases
Pitch, bbls. of, each	7		6 bbls.	120 bbls.
Plaster, bbls. of, each	6.3		8 bbls.	160 bbls.
Potatoes, sacks of, 125 lbs. each	3.3	16 sacks	12 sacks	240 sacks
" bushels of, 60 lbs. each		33.3 bush.	32 bushels	360 bushels
Powder, cases or kegs of	1		40 c. or k.	800 kegs
Resin, bbls. of, each	7		6 bbls.	120 bbls.
Salt, bay, sacks, 110 lbs. each		19 sacks		380 sacks
" Carman Island or Liverp'l, 100 lbs		20 sacks		400 sacks
" Liverpool, sacks 220 lbs		10 sacks		200 sacks
" " gunnies of 250 lbs.		9 sacks		180 sacks
Shot, kegs of, 250 lbs. each		8 kegs		160 kegs
" lead, kegs of, 100 lbs. each		20 kegs		400 kegs
Shovels, cases of, each	29		2 cases	40 cases
Soap, castile, boxes of, each	1		40 boxes	800 boxes
" boxes of, each	.6		80 boxes	1,600 boxes
Spices, boxes of, each	.7		70 boxes	1,400 boxes
Starch, " " "	.6		80 boxes	1,600 boxes
Stone, granite, cubic feet of		13½ cu. ft.	40 cu. ft.	121 cu. ft.
" sandstone, cubic feet of		16.4 cu. ft.	40 cu. ft.	133 cu. ft.
" rubble, perch of	24¾		1.6 perch	6 perch
Stove Castings, 250 lbs. per stove		8 stoves		160 stoves
Stoves, each (set up)	12		3½ stoves	70 stoves
Sugar, bbls., each	7		6 bbls.	120 bbls.
" ½ bbls., each	3.6		14½ ½ bbls	285½ bbls.
Sirup, bbls., each	6.9		6 bbls.	120 bbls.
" ½ bbls, each	3.4		12½ ½ bbls	245½ bbls.
" kegs, each	1.3		32 kegs	640 kegs
Tar, bbls., each	7		6 bbls.	120 bbls.
Tea, China, chests of	2.8		14 chests	280 chests
Tea, Japan, chests of	2.2		18 chests	360 chests
Tin, boxes of, 120 lbs. each	4		10 nests	200 nests
Tobacco, boxes, small, each	2		80 boxes	1,600 boxes
Trunks, nests, each	2.4		17 boxes	340 nests
Tubs and Pails, nests, each	4.6		10 nests	200 nests
Washboards, packages of, each	10		4 packages	80 pack'ges
Windows, packages of, each	4		12 pack'ges	240 "
Wool, bales of, 300 lbs. each	3.5	7 bales	11½ bales	140 bales

MISCELLANEOUS WEIGHTS AND MEASURES

4 Inches	=	A Hand.
3 Inches	=	A Palm.
9 Inches	=	A Span.
18 Inches	=	A Cubit.
36 Inches *or* 3 Feet	=	A Pace.
28 Inches *or* 2⅓ Feet	=	A Military Pace.
33.38676 Inches	=	1 Vara.
25 Pounds	=	1 Keg of powder.
56 Pounds	=	1 Firkin of butter.
100 Pounds	=	1 Cental of grain.
100 Pounds	=	1 Cask of raisins.
100 Pounds	=	1 Quintal of dried fish.
196 Pounds	=	1 Barrel of flour.
200 Pounds	=	1 Barrel of beef, pork or fish.
256 Pounds	=	1 Barrel of soap.
280 Pounds	=	1 Barrel of salt.

IRON OR LEAD.

14 Pounds	=	1 Stone.
21½ Stone	=	1 Pig = 301 pounds.
8 Pigs	=	1 Fother=2,408 pounds=172 stone.

TABLE OF THE FRACTIONAL PARTS OF AN INCH, (of 32 parts) and foot of 12 inches, reduced to Decimals.

Inch=	Decimals	Inch=	Decimals	Inch=	Decimals	Foot=	Decimals	Foot=	Decimals
1 =	1.00000	21-32=	.65625	5-16=	.3125	12-12=	1.00000	⅙ =	.16666
31-32=	.96875	⅝ =	.625	9-32=	.28125	11-12=	.9166	1-12=	.08333
15-16=	.9375	19-32=	.59375	¼ =	.125	5-6 =	.83333	7-96=	.07291
29-32=	.90625	9-16=	.5625	7-32=	.21875	¾ =	.75	3-48=	.0625
⅞ =	.875	17-32=	.53125	3-16=	.1875	⅔ =	.66666	5-96=	.0528
27-32=	.84375	½ =	.5	5-32=	.15625	7-12=	.58333	1-24=	.04166
13-16=	.8125	15-32=	.46875	⅛ =	.125	½ =	.5	1-32=	.03125
25-32=	.78125	7-16=	.4375	3-32=	.09375	5-12=	.41666	1-48=	.02083
¾ =	.75	13-32=	.40625	1-16=	.0625	⅓ =	.33333	1-96=	.010415
23-32=	.71875	⅜ =	.375	1-32=	.03125	¼ =	.25	1-99=	.010101
11-16=	.6875	11-32=	.34375						

Table of the Decimal parts of a Pound—(16 oz's.)

Ounces=	Decimals.	Ounces=	Decimals.	Ounces=	Decimals.	Ounces=	Decimals.	Ounces=	Decimals.
16 =	1.0000	12½=	.78125	9 =	.5625	5½=	.34375	2 =	.125
15½=	.96875	12 =	.75	8½=	.53125	5 =	.3125	1½=	.09375
15 =	.9375	11½=	.71875	8 =	.5	4½=	.28125	1 =	.0625
14½=	.90625	11 =	.6875	7½=	.46875	4 =	.25	½ =	.03125
14 =	.8875	10½=	.65625	7 =	.4375	3½=	.21875		
13½=	.84375	10 =	.625	6½=	.40625	3 =	.1875		
13 =	.8125	9½=	.59375	6 =	.375	2½=	.15625		

NUMBER OF CUT NAILS IN ONE POUND (NEW STANDARD), weighed on a Fairbanks & Co.'s scales at the establishment of Huntington, Hopkins & Co., San Francisco by the editor hereof personally.

Penny	3	3	4	5	6	7	8	9	10	12	16	20	30	40	50	60
Length, inches	1⅛	1¼	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	4	4½	5	5½	6
No. in pound, fine	673	369	275¾	191¾	154¼	124¼	89¾	71½	62¼	46¾	33½	23½	18¼	14⅜	12⅛	8½

NUMBER AND LENGTH OF TACKS IN ONE POUND.

Oz.	1	1½	2	2½	3	4	6	8	10	12	14	16	18	20	22	24
Inch	⅛	3/16	¼	5/16	⅜	7/16	9/16	⅝	11/16	¾	13/16	⅞	15/16	1	1 1/16	1⅛
No. in lb.	16000	10666	8000	6400	5333	4000	2666	2000	1600	1333	1143	1000	888	800	727	666

APPROXIMATE NUMBER OF STEEL WIRE NAILS PER POUND.

Length, Inches.	3-16	¼	⅜	½	⅝	¾	⅞	1	1⅛	1¼	1½	1¾	2	2¼	2½	2¾	3	3½	4	4½	5	6	7	8	9	10	11	12
Penny.						1d		2d	3df	3d	4d	5d	6d	7d	8d	9d	10	16	20	30	40	60	[Spikes.]					
Roebling Gauge.																												
No 00.										33	27	23	20	18	16	15	14	12	10	9	8	7	6	5	4½	4	3¾	3¼
" 0.										34	29	25	21	19	17	16	15	13	11	10	9	8	7	5½	5	4⅓	4	3½
" 1.								57	50	45	38	32	28	25	23	21	19	16	14	13	11	10	8	7	6	5½	5	4½
" 2.								65	58	52	44	37	32	29	26	24	22	19	16	14	13	11	9	8	7	6½	6	5½
" 3.						100	87	76	67	60	50	43	38	34	30	28	25	22	19	17	15	13	11	10	8	7½		
" 4.						120	103	90	80	72	60	51	45	40	36	33	30	26	23	20	18	15	13	11	10	9		
" 5.				211	169	141	121	106	94	85	71	60	53	47	42	39	35	30	26	24	21	18	15					
" 6.				247	197	164	141	123	111	99	82	71	62	55	50	45	41	35	31	28	25	21	18					
" 7.				299	239	200	171	149	133	120	100	85	75	67	60	54	50	43	37	33	30	25						
" 8.				345	275	229	197	172	153	137	115	98	86	76	69	62	57	49	43	39	35	29						
" 9.				414	331	276	236	207	184	165	135	118	103	92	82	75	69	59	52	46	41							
" 10.			633	496	397	333	283	248	220	198	165	142	124	110	99	90	83	71	62	55	50							
" 11.			837	628	502	418	359	314	279	251	209	179	157	139	125	114	105	90	79	70								
" 12.			1096	822	658	548	469	411	365	329	274	234	204	182	164	149	137	117	103									
" 13.			1429	1072	857	714	613	536	476	429	357	306	268	238	214	195	178	153										
" 14.		2840	1893	1420	1136	947	811	710	631	568	473	406	350	315	284	258	236											
" 15.		3504	2336	1752	1402	1168	1001	876	778	701	584	500	438	389	350													
" 16.		4571	3048	2280	1828	1523	1305	1143	1015	913	761	653	571	508														
" 17.		6233	4156	3116	2495	2077	1781	1558	1385	1246	1038	899	779															
" 18.		8276	5517	4138	3310	2758	2364	2069	1839	1655	1379	1182																
" 19.		10668	7112	5334	4267	3556	2933	2667	2370	2133	1778																	
" 20.	20000	15000	10000	7500	6000	5001	4400	3750	3333	3000																		
" 21.	23702	17777	11850	8888	7111	5926	5079	4444																				
" 22.	30476	22856	15237	11428	9143	7618																						

These approximate numbers are an AVERAGE only, and the figures given may be varied either way, by changes in the dimensions of the heads or points.

MISCELLANEOUS MEASUREMENTS.

Bricks.

Variations in dimensions by various manufacturers, and different degrees of intensity of their burning, render a table of exact dimensions of different manufactures and classes of bricks altogether impracticable. Average dimensions of the following descriptions of brick:

DESCRIPTION.	INCHES.	DESCRIPTION.	INCHES.
Baltimore.... / Philadelphia / Wilmington. { Front or Pressed }	8.25x4.125x2.375	Maine........	7.5 x3.375x2.375
		Milwaukee........	8.5 x4.125x2.375
		North River........	8 x3.5 x2.25
Croton........	8.54 x2.25	Ordinary........	7.75 x3.625x2.25 / 8 x4.125x2.5
Colabaugh........	8.25x3.625x2.375		
Eng. ordinary........	9 x4.5 x2.5	San Francisco........	8.25 x4.125x2.5
" Lond. stock........	8.75x4.25 x2.5	Stourbridge, fire brick..	9.125x4.625x2.375
Dutch Clinker........	6.25x3 x1.5	Amer. N. Y. " " ..	8.875x4 5 x2.625

Variations in dimensions of bricks, and thickness of the layer of mortar or cement in which they may be laid, make it impracticable to give any rule of general application for volume of laid brickwork.

Volume of bricks in masonry may be found as follows:

RULE.—Face dimensions of particular bricks used, add one-half thickness of the mortar or cement in which they are laid, and compute the area; divide width of wall by number of bricks of which it is composed; multiply this area by quotient thus obtained, and product will give volume of the mass of a brick and its mortar in inches. Divide 1,728 by this volume, and quotient will give number of bricks in a cubic foot.

By the above rule, the number of bricks contained in a cubic foot of "Philadelphia front," manufacture=**18.22** bricks. The average weight of a cubic foot of brickwork in mortar is about 102 pounds.

Laths are 1¼ to 1½-inch by four feet in length, set ¼ of an inch apart, and a bundle contains 100. It takes 20 laths to cover 1 square yard.

Plastering.—In measuring plasterers' work, all openings, as doors, windows, etc., are computed at one-half their areas, and cornices are measured upon their extreme edges, including that cut off by mitering. In weight, plastering, lathing, and furring, will average 9 pounds per square foot.

Glazing.—In glaziers' work, oval and round windows are measured as squares.

CUBIC FEET IN A TON OF HAY: 270 cubic feet of new meadow hay, or 243 cubic feet of hay from old stacks will weigh a ton; 297 to 324 cubic feet of dry clover weigh a ton; 512 cubic feet of oat or wheat hay, in Cal., are taken for a ton; Gov't officials in the Pacific States purchase hay at the latter figure. No two States accept the same measurement,

CHARCOAL, WEIGHT AND MEASUREMENT.

The best quality of charcoal is made from beech, chestnut, maple, oak and pine. Wood will furnish, when properly burned, about 23 per cent. of coal. Oak charcoal absorbs about 4.28 and pine 8.9 per cent. of water.

One bushel of charcoal contains 2,747.7 cubic inches; and if made from red or white pine will weigh 22 lbs.; if made of oak, or triturated, will weigh from 30 to 43 lbs.

CASTINGS AND PATTERNS COMPARED.

Rule.—Multiply the weight of the pattern (*of white pine*) in pounds by the following multiplier, and the product will give the weight of the casting: brass, 15; iron, 14; lead, 22; tin, 14; zinc. 13.5.

Leather Belting, and all substances in Rolls and Coils.—To find the length of a roll of belting; measure (in inches) the diameter of the roll, and the diameter of the hole in the center of the roll, add the two diameters together, divide the result by 2, then multiply that quantity by 3.1416, multiply this last amount by the number of coils or folds in the roll, and you have the length of the belt in inches. How many feet of belting in a roll 31 in's in diameter, hole in center 4 in's in diameter, number of folds 100? Example.—31 4 = 35; 35 ÷ 2 = 17.50; 17.50 × 3.1416 = 54.978; 54.978 × 100 = 5,497.800; 5,497.800 ÷ 12 = 458.150 feet. Another.—Count the number of folds of belting between the center of the coil and its circumference (= n); measure the diameter of the coil (=D); measure the diameter of the circular hole in the center of the coil (=d); then add the outside diameter (D) to the inside diameter (d) and multiply this sum (D+d) by the number of folds (n), and this product by 1.5708; the result of the multiplication is the length of the belting L); or in a formula: $L = 3.1416 \times n \times \left(\frac{D+d}{2}\right) = 1.5708 \times n \times (D+d)$. (This last formula by C. Ewald Grunsky, C. E.)

MECHANICS—*Miscellaneous.*

Mechanics, that branch of applied mathematics which treats of forces and equilibrium. There are two divisions, Statics and Dynamics, the first embracing equilibrium of forces or bodies at rest, the second of bodies in motion. There is a further division into mechanics of solid, fluid, and aeriform bodies, classed under the names, Geostatics, Geodynamics (solids); Hydrostatics, Hydrodynamics (fluids); Aerostatics, Pneumatics (gases). Forces either have motion or resistance, and may be summed up as follows: Gravity, Muscle, Elasticity, Central, Heat, Magnetism, Percussion, Expansion, Inertia, Cohesion, Adhesion, Explosion.

Electricity is a form of persistent force, and is evolved in any disturbance of molecular equilibrium, whether from a chemical, physical or mechanical cause. According to the British Association tables, the electrical unit of resistance is termed an *Ohm*, which represents resistance of a column of mercury of 1 sq. millimeter in section, and 1.0486 meters in length, at temperature 0° C. It is equivalent to resistance of a wire 4 millimeters in diameter and 100 meters in length.

One microhm = 10 absolute electro magnetic units; 1,000,000 microhms = 1 ohm, or 10,000,000 absolute electro magnetic units; 1,000,000 ohms = 1 megohm, or 10^{13} absolute electro magnetic units. The unit of electro motive force, or difference of potentials is the *volt.*

One microvolt = .1 of an absolute electro magnetic unit; 10 microvolts = 1 absolute electro magnetic unit; 1,000,000 microvolts = 1 volt, or 100,000 absolute electro magnetic units; 1,000,000 volts = 1 megavolt.

The unit of electro current is equal to 1 weber per second, or the current in a circuit has an electric motive force of one *volt* and a resistance of an *ohm.*

The unit of electric volume is called ampere, and represents that volume of electricity which flows through a circuit having an electro motive force of 1 *volt* and a resistance of 1 *ohm* in a second, or it represents a *volt* diminished by an *ohm.* One million microvolts or 100 absolute units of volume = 1 *ampere.* 1,000,000 amperes = 1 megawber. The unit of electric capacity is called a *farad.* 1,000,000 microfarads, or 10,000,000 absolute units of capacity = 1 *farad.* 1,000,000 *farads* = 1 megafarad. An electric current with 30 Faure cells, 74 *volts*, 1.81 *ampere*, is equal to 16 standard candles; with 50 like cells, 124 *volts*, and 3.2 amperes, it is equal to 333 similar candles, in producing the light of a Maxim incandescent lamp.

Gravity acts equally on all bodies at equal distances from the earth's center, its force diminishing as the distance increases, and increasing as the distance diminishes. Bodies attract each other directly as their masses, and inversely as squares of their distances. The specific gravity of a body is the proportion it bears to the weight of another body of known density or of equal volume, taken as a standard. Bodies moving around a center have a tendency to fly off in a tangent, centrifugally. The attraction of the central fixed point is the centripetal force, opposed to centrifugal, and producing an orbital balance. Kepler first announced in his three laws the astronomical application of this principle; Newton verified and extended it universally.

Heat or Caloric is a mode of motion or manifestation of universal persistent force. For expressing and measuring quantities of heat, a thermal unit is employed. This unit of heat is the quantity of heat which corresponds to an interval of 1° in the temperature of 1 lb. of pure liquid water, at or near its temperature of greatest density. The mechanical equivalent of heat is 772, as the mechanical power required to raise one pound 772 feet will generate one unit of heat. Air and gases are very bad conductors of heat. In heating rooms with air, the hot air should be let in at the bottom. Double windows owe their utility to the body of air between them which transmits heat imperfectly. Asphalt is the best composition for resisting moisture; it is a slow conductor and economizes heat and dryness. Slate is very dry, but conducts quickly, and will not retain heat. Plaster of Paris and woods make good lining for rooms, because they are poor conductors, while a composition of hair and lime is a quick conductor and very cold. Fire-brick absorbs much heat, and makes good lining for fireplaces, while iron is a high conductor, and the worst substance for that purpose. Underground temperature increases 1° with every 64 feet downward from surface.

Light.—Solids shine in the dark only at a temperature of 600° to 700° and at 1,000° in the day. The intensity of light is inversely as the square of distance from the luminous body. The light of the sun travels at the rate of 185,000 miles a second. The standard measure of light is the candle power of a short 6 sperm, burning 120 grs. per hour. One thousand cubic feet of 13 candle coal gas is equal to 7.5 gal. of sperm oil, 52.9 lbs. of mold candles and 44.6 lbs. of sperm candles. The higher the flame from a gas burner, the greater the intensity of the light, the most effective height being 5 inches.

A Square of Slate is 100 superficial feet. Gauge is the distance between the courses of the slates. Lap is the distance which each slate overlaps the slate lengthwise next but one below it, and it varies from 2 to 4 inches; the standard is 3 inches. Margin is width, of course, exposed or distance between tails of the slates. Pitch of a slate roof should not be less than 1 in height to 4 of length.

MECHANICS—MISCELLANEOUS—Concluded.

Horse-power.—HP measures the rate at which work is done. One horse-power is reckoned as equivalent to raising 33,000 lbs. one foot high per minute, or 550 lbs. per second. It is called nominal, indicated, or actual. *Nominal* is used by manufacturers of steam engines to express the capacity of an engine, the elements being confined to the dimensions of steam cylinder, and a conventional pressure of steam and speed of piston. *Indicated* shows the full capacity of the cylinder in operation without deductions for friction. *Actual* marks its power as developed in operation involving elements of mean pressure upon the piston, its velocity, and a just deduction for friction of engine's operation.

Mechanical Powers are only three, viz.: the lever, inclined plane, and pulley. The wheel and axle, wedge and screw are only combinations of the three simple powers.

The Strength of Material is the resistance which a body offers to a separation of its parts, and is measured by the degree of its resistance to forms of force called Crushing, Detrusive, Tensile, Torsion, and Transverse. Cohesion is the quality by which the particles of bodies remain in contact. Elasticity is the quality of a body by which it resists changes of form. The resilience of a body is a combination of strength and flexibility. The deflection, bending, or variation of girders, beams, and bars depends chiefly upon their form. Continuous weights equal to those which girders, etc., are suited to bear will not cause their deflection to increase unless they are subjected to important changes of temperature. The heaviest load on a railway girder ought not to exceed .16 of such a weight as would destroy the girder if laid on in state of rest. The deflection of girders, etc., fixed at one end and loaded at the other, is 32 times that of the same when supported at both ends and loaded in the middle. Deflection is greatly increased by instantaneous loading, sometimes doubled. The momentum of a railway train in deflecting beams, or girders, is greater than its simple dead weight, and the deflection increases with the velocity of the weight. Beams broken by a running load are always fractured at points beyond their centers. The heaviest running weight is that of locomotives, 2 tons per linear foot. Girders must not be deflected more than .025 inch to a foot in length.

An Alloy is the proportion of a baser metal mixed with a finer or purer. *Amalgam* is a compound of mercury and a metal making a soft alloy; *compositions* of copper contract in admixture, and all *amalgams* expand. The less fusible metals should be melted first when alloys and compositions are made. Increase of the zinc proportion in composition of brass is followed by a decrease of malleability. The tenacity of brass is impaired by addition of lead or tin. Steel alloyed with ore five-hundredth part of platinum or silver is rendered harder, more malleable, and better adapted for cutting instruments. The specific gravity of alloys does not follow the ratios of their ingredients, being sometimes above or below the mean. Brass is an alloy of copper and zinc; bronze, of tin and copper.

Gun Barrels to shoot well must not be less than 44 times diameter of bore nor more than 47 measured from the vent hole.

Mortar should be so mixed with lime or cement paste that the volume of cementing substance should be somewhat in excess of volume of voids or spaces in the sand or coarse material to be united, so that there may be enough to counteract the imperfect manipulation of the mass.

Portland Cement requires less water than Roman cement, sets slowly, and can be remixed with additional water after an interval of 12 or 24 hours from its first mixture. It improves by age if kept from moisture. The longer in setting the stronger it will be. Cleaner and sharper the sand, greater the strength. Strong cement is heavy; blue gray, slow setting. Quick setting generally has too much clay in its composition, is brownish and weak. Less water used in mixing cement, the better. Brick, stones, etc., used with cement should be well wetted before using. Cement setting under still water will be stronger than if kept dry. Bricks of Portland cement in a few months are equal to the best pressed or face. When concrete is being used, a current of water will wash away the cement. Artificial cement is made by a combination of slaked lime with unburned clay in suitable proportions. Salt water has a tendency to decompose cements of all kinds, and their strength is considerably impaired by their mixture with it. Whence it follows that cement in a climate like that of San Francisco, with a saline atmosphere and moderate rainfall, is not economical material, while in a climate like that of Arizona, it would be the most satisfactory for structures and all works not in or near water courses and lakes.

Scales and Balances.—To detect fraudulent balances after en equilibrium has been established between the weight and the article, transpose them and the weight will preponderate, if the article is lighter than the weight, and *vice versa*. To ascertain true weight, discover the weight which will produce equilibrium after the article and weight have been transposed; reduce these weights to the same denomination, multiply them together and the square root of their product will give true weight.

MISCELLANEOUS MEASURES

LEATHER WEIGHT.—A kilo in leather weight, is=2.20462124 lbs. avoirdupois; leather spoken of as 14 kilo, means that 12 skins weigh 14x2.2046+=30.864697, or approximately 30⅞ lbs.; and so on for a greater or less number of kilos.

SHOEMAKERS' MEASURE.—No. 1 small size is 4⅛ ins., inside length, and every succeeding number increases ⅓ of an inch to 13. No. 1 large size is 8 and 11-24 ins., and every succeeding number increases ⅓ of an inch to 15.

HOSE.—The numbers, of hose or stockings, viz: 6, 7, 8, 8½, 9, etc., indicate the exact length of the foot of the hose in inches.

HATTER'S MEASURE.—The measure around the head to be taken just where the hat is accustomed to rest, and for the following sizes is as follows: Size 5⅞,=18.45 ins. around the head; 6,=18.85 ins.; 6⅛,=19.24 ins.; 6¼,=19.63 ins.; 6⅜,=20.03 ins.; 6½,=20.42 ins.; 6⅝,=20.81 ins.; 6¾,=21.20 ins.; 6⅞,=21.60 ins.; 7,=21.99 ins.; 7⅛,=22.38 ins.; 7¼,=22.77 ins.; 7⅜,=23.16 ins.; 7½,=23.56 ins.; 7⅝,=23.95 ins.; 7¾,=24.34 ins.; 7⅞,=24.74 ins.; 8,=25.13 ins.; 8⅛,=25.52 ins.; 8¼,=25.91 ins.

SIZES OF HATS WORN BY EMINENT MEN.—Dean Stanley, No. 6¾; Lord Beaconsfield, 7; Prince of Wales, 7; Robert Burns, 7⅛; Chas. Dickens, 7⅛; Gen. W. T. Sherman, 7⅛; Stephen A. Douglas, 7¼; James G. Blaine, 7¼; Wm. E. Gladstone, 7⅜; James A. Garfield, 7⅜; Gen. U. S. Grant, 7⅜; Henry Clay, 7⅜; Grover Cleveland, 7½; Daniel Webster, 8; Daniel O'Connell, 8; Samuel J. Tilden, 8⅛.

WEIGHT OF BELLS OF THE WORLD.

BELLS.	Lbs.	BELLS.	Lbs.	BELLS.	Lbs.
Moscow, Russia....	432,000	Montreal, Canada...	28,560	St. Paul's, London..	11,470
St. Ivan's, Moscow.	127,830	City Hall, N. Y.....	22,300	Linden, Germany..	10,854
Vienna, Austria....	40,200	Fire Alarm, 33d st.,		Lewiston, Maine....	10,233
Olmutz, Bohemia...	40,000	New York City....	21,612	Worcester, England	6,600
Rowen, France.....	40,000	St. Peter's, Rome...	18,600	York, England......	6,384
"Big Ben," London.	30,350	"Great Tom" Oxford	18,000		

WEIGHT AND SPECIFIC GRAVITY

Of Liquids, Metals, Mineral Substances and Woods.

NOTE.—The Specific Gravity of a body is the proportion it bears to the weight of another body of known density. An immersed body, ascending or descending in a fluid, has a force equal to the difference between its own weight and the weight of its bulk of the fluid, less the resistance of the fluid to its passage.

Water is well adapted for the standard of gravity; and as a cubic foot of it weighs 1,000 ounces avoirdupois, its weight is taken as the unit, viz., 1,000.

To find the weight of any substance, the specific gravity being known, divide the specific gravity by 16, and the quotient will give the weight of a cubic foot of it in pounds.

In this Table, Fluids at 32° Fahr. (except water, which is taken at 39°.1 Fahr.).

LIQUIDS.	Weight of a cubic foot in pounds, avoirdupois.	Specific gravity, pure Water =1.	LIQUIDS.	Weight of a Cubic foot in pounds, avoirdupois.	Specific gravity, pure Water, =1.
Acid, Acetic..............	66.375	1062	Alcohol, 40 per cent.....	59.437	951
" Benzoic..........	41.687	667	" 25 "	60.625	970
" Citric..............	64.625	1034	" 10 "	61.625	986
" Concentrated.......	95.062	1521	" 5 "	62.000	992
" Fluoric	93.750	1500	Ammonia, 27.9 per cent..	55.687	891
" Muriatic	75.000	1200	Aquafortis, double......	81.250	1300
" Nitric.......	76.062	1217	Aquafortis, single.......	75.000	1200
" Phosphoric	97.375	1558	Beer......	64.625	1034
" " solid ...	175.000	2800	Bitumen, liquid........	53.000	848
" Sulphuric	115.562	1849	Blood, human...........	65.875	1054
Alcohol, pure, 60°.......	49.622	794	Brandy, 5-6 or 5 of spirit	57.750	924
" 95 per cent.....	51.000	816	Cider	63.625	1018
" 80 "	53.937	863	Ether, acetic............	54.125	866
" 50 "	58.375	934	" muriatic.........	52.812	845

Weight and Specific Gravity—Continued.

LIQUIDS.	Weight of a cubic foot in pounds, avoirdupois.	Specific gravity pure water = 1.	LIQUIDS.	Weight of a cubic foot in pounds, avoirdupois.	Specific gravity pure water = 1.
Ether, sulphuric	44.687	715	Spirit, rectified	51.500	824
Honey	90.625	1450	Tar	63.437	1015
Mercury	849 750	13596	Vinegar	67.500	1080
Milk	64.500	1032	Water, Dead Sea	77.500	1240
Oil, Anise-seed	61.625	986	" 60°	62.449	999
" Codfish	57.687	923	" 212°	59 812	957
" Linseed	58.750	940	" distilled, 39°	62.379	998
" Naphtha	53.000	848	" Mediterranean	64.312	1029
" Olive	57.187	915	" **rain**	**62.500**	**1000**
" Palm	60.562	969	" sea	64.125	1026
" Petroleum	54.875	878	Wine, Burgundy	62.000	992
" Rape	57.125	914	" Champagne	64.375	997
" Sunflower	57.875	926	" Madeira	64.875	1038
" Turpentine	54.375	870	" Port	62.312	997
" Whale	57.687	923			
METALS—Solids.			METALS—Solids.		
Aluminium	160.000	2560	Manganese	500.000	8000
Antimony	419.500	6712	Mercury—40°	977.000	15632
Arsenic	360.187	5763	" +32°	849 875	13598
Barium	29.375	470	" 60°	848.750	13580
Bismuth	613.937	9823	" 212°	835.625	13370
Brass. { Copper, 84	532.000	8832	Molybdenum	537.500	8600
Tin, 16			Nickel	550.000	8800
" { Copper, 67	488.750	7820	" cast	517.437	8279
Zinc, 33			Osmium	1402.981	22[illegible]
" Plate	523.750	8380	Palladium	709.375	11350
" Wire	533.750	8214	Platinum, hammered	1271.062	20337
Bronze, gun metal	543.750	8700	" native	1000.000	16000
Boron	125.000	2000	" rolled	1379.312	22069
Bromine	187.500	3000	Potassium, 59°	54.062	865
Cadmium	540.625	8650	Red-lead	558.750	8940
Calcium	98.750	1580	Rhodium	665 625	10650
Chromium	368.750	5900	Ruthenium	537.500	8600
Cinnabar	506.125	8098	Selenium	281.250	4500
Cobalt	537.500	8600	Silicium	....	.....
Columbium	375.000	6000	Silver, pure, cast	654.625	10474
Copper, cast	549.250	8788	" " hammered	656.937	10511
" Plates	543.625	8698	Sodium	60.625	970
" Wire	555.000	8880	Steel, plates	487.875	7806
Gold, pure, cast	1203.625	19258	" soft	489.562	7833
" hammered	1210.062	19361	" tem. and hardened	488.625	7818
" 22 carats fine	1092.875	17486	" wire	490 437	7847
" 20 "	981.812	15709	Strontium	158.750	2540
Iridium	1167.500	18680	Tin, Cornish, hammered	461.875	7390
" hammered	1437.500	23000	" " pure	455.687	7291
Iron, cast	450.437	7207	Tellurium	381.875	6110
" cast gun metal	456.750	7308	Thallium	740.625	11850
" wrought bars	486.750	7788	Titanium	331.250	5300
" " wire	485.875	7774	Tungsten	1062.500	17000
" rolled plates	481.500	7704	Uranium	1145.625	18330
Lead, cast	709.500	11352	Wolfram	444.937	7119
" rolled	711.750	11388	Zinc, cast	428.812	6861
Lithium	36.875	590	" rolled	449.437	7191
Magnesium	109.375	1750			

NOTE.—The number of elements as at present recognized is 72, forty-seven of which are metals.

Weight and Specific Gravity—Continued.

MINERAL SUBSTANCES, ETC.	Weight of a cubic foot in pounds, avoirdupois.	Specific Gravity pure water = 1.
Agate	161.875	2590
Alabaster, white	170.625	2730
" yellow	168.687	2699
Alum	107.125	1714
Amber	67.375	1078
Ambergris	54.125	866
Asbestos	192.062	3073
Asphaltum	56.562	905
	103.125	1650
Barytes, sulphate	250.000	4000
	304.062	4865
Basalts	171.250	2740
	179.000	2864
Borax	107.125	1714
Brick	118.750	1900
	85.437	1367
" fire	137.562	2201
" work in cement	112.500	1800
" " mortar	100.000	1600
	125.000	2000
Carbon	218.750	3500
Cement, Portland	81.250	1300
" Roman	97.250	1560
Chalk	95.000	1520
	174 000	2784
Chrysolite	173.871	2782
Clay	120.625	1930
" with gravel	155.000	2480
Coal, Anthracite	89.750	1436
	102.500	1640
" Borneo	80.625	1290
" Caking	79.812	1277
" Cannal	77.375	1238
	82.375	1318
" Cherry	79.750	1276
" Chili	80.625	1290
" Derbyshire	80.750	1292
" Lancaster	79.562	1273
" Maryland	84.687	1355
" Newcastle	79.375	1270
" Rive de Gier	81.250	1300
" Scotch	78.687	1259
	81.250	1300
" Splint	81.375	1302
" Wales, mean	82.187	1315
Coke	62.500	1000
" Nat'l, Va	46.640	746
Concrete, mean	125.000	2000
Copal	65.312	1045
Coral, red	168.750	2700
" white	159.375	2550
Cornelian	163.312	2613
Diamond, Oriental	220.062	3521
" Brazilian	215.250	3444
Earth, common soil dry	76.000	1216
" loose	93.750	1500
" moist sand	128.125	2050
" mould, fresh	128.125	2050
" rammed	100.000	1600
" rough sand	120 000	1920
" with gravel	126.250	2020
Emery	250.000	4000

MINERAL SUBSTANCES, ETC.	Weight of a cubic foot in pounds, avoirdupois.	Specific Gravity pure water = 1.
Flint, black	161.375	2582
" white	162.125	2594
Fluorine	82.500	1320
Garnet	261.812	4189
" black	234.375	3750
Glass, bottle	170.750	2732
" crown	155.437	2487
" flint	183.312	2933
	196.000	3200
" green	165.125	2642
" optical	215.625	3450
" white	180.750	2892
" window	165.125	2642
Granite, Egyptian red	165.875	2654
" Patapsco	165.000	2640
" Quincy	165.750	2652
" Scotch	164.062	2625
" Susquehanna	169.000	2704
Gravel, common	109.312	1749
Grindstone	133.937	2143
Gypsum, opaque	135.500	2168
Hone, white razor	179.750	2876
Hornblende	221.250	3540
Iodine	308.750	4940
Jet	81.250	1300
Lime, hydraulic	171.562	2745
" quick	50.250	804
Limestone, green	198.750	3180
" white	197.250	3156
Magnesia, carbonate	150.000	2400
Marble, Adelaide	169.687	2715
" African	169.250	2708
" Biscayan, black	168.437	2695
" Carara	169.750	2716
" common	167.875	2686
" Egyptian	166.750	2668
" French	165 562	2649
" Italian, white	169.250	2708
" Parian	177.375	2838
" Vermont, white	165.625	2650
Marl, mean	109.375	1750
Mica	175.000	2800
Millstone	155.250	2484
Mortar	86 500	1384
	109.375	1750
Mud	101.875	1630
Nitre	118.750	1900
Opal	132.125	2114
Oyster-shell	130.750	2092
Paving-stone	151.000	2416
Pearl, Oriental	165.625	2650
Peat	37.500	600
	83.062	1329
Phosphorus	110.625	1770
Plaster of Paris	73.500	1176
Plumbago	131.250	2100
Porphyry, red	172.812	2765
Porcelain, China	143.750	2300
Pumice-stone	57.187	915
Quartz	166.250	2660
Red-lead	558.750	8940
Resin	68.062	1089

Weight and Specific Gravity—Continued.

Mineral Substances, Etc.	Weight of a cubic foot in pounds, avoirdupois.	Specific gravity, pure water = 1.
Rock, crystal	170.937	2735
Rotten-stone	123.812	1981
Ruby	267.687	4283
Salt, common	133.125	2130
Saltpetre	130.625	2090
Sand, coarse	112.500	1800
" common	104.375	1670
" damp and loose	97.500	1560
" dried and loose	87.000	1392
" dry	88.750	1420
" morter	103.625	1659
" " Brooklyn	107.250	1716
" silicious	106.312	1701
Sapphire	249.625	3994
Schorl	198.125	3170
Shale	162.500	2600
Slate {	167.000	2672
	181.250	2900
" purple	174.000	2784
Smalt	152.500	2440
Spar, Calcareous	170.937	2735
" Feld, blue	168.312	2693
" " green	169.000	2704
" Fluor	215.500	3400
Stalactite	150.937	2415
Stone, Bath, Eng	122.562	1961
" Blue Hill	165.000	2640
" Bluestone (Basalt)	164.062	2625
" Breackneck, N. Y.	169.000	2704
" Bristol, Eng	156.875	2510
" Caen, Normandy	129.750	2076
" Common	157.500	2520
" Craigleth, Eng	144.750	2316
" Kentish Rag, Eng.	165.687	2651
" Kip's Bay, N. Y.	172.437	2759
" Norfolk	144.000	2304
" Portland, Eng	148.000	2368
" Sandstone, mean	137.500	2200
" " Sydney	139.812	2237
" Staten Island, N.Y.	186.000	2976
" Sullivan Co., N. Y.	168.000	2688
Talc, mean	156.250	2500
Talc, black	181.250	2900
Tile	113.437	1815
Topaz, Oriental	250.625	4011
Trap	170.000	2720
Turquoise	171.087	2750

Miscellaneous Substances.	Weight of a cubic foot in pounds, avoirdupois.	Specific gravity, pure water = 1.
Asphaltum {	56.562	905
	103.125	1650
Atmospheric Air	.0753125	.001205
Beeswax	60.312	965
Butter	58.875	942
Camphor	61.750	988
Caoutchouc	56.437	903
Egg	68.125	1090
Fat of Cattle	57 687	923
" Hogs	58.500	936
" Sheep	57.687	923
Gamboge	76.375	1222
Gum Arabic	90.750	1452
Gunpowder, loose	56.250	900
" shaken	62.500	1000
" solid {	96.875	1550
	112.500	1800
Gutta-percha	61.250	980
Horn	105.562	1689
Ice at 32°	57.500	920
Indigo	63.062	1009
Isinglass	69.437	1111
Ivory	114.062	1825
Lard	59.187	947
Mastic	67.125	1074
Myrrh	85.000	1360
Opium	53.500	1336
Soap, Castile	56.937	1071
Spermaceti	58.937	943
Starch	59.375	950
Sugar	100.375	1606
" .66 {	82.875	1326
	60.250	972
Tallow	58.812	941
Wax {	60.250	964
	60.625	970

Woods, Dry.	Weight of a cubic foot in pounds, avoirdupois.	Specific gravity, pure water = 1.
Alder	50.000	800
Apple	49.562	793
Ash	52.812	845
" extra dry	45.125	722
Bamboo	25.000	400
Bay	51.375	822
Beech, extra dry	39.000	624
" {	43.125	690
	53.250	852
Birch	35.437	567
Box, Brazilian	64.437	1031
" Dutch	57.000	912
" French	83 000	1328
Bullet-wood	58.000	928
Butternut	23.500	376
Campeachy	57.062	913
Cedar	35.062	561
" Indian	82.157	1315
Charcoal, pine	27.562	441
" fresh burned	23.750	380
" oak	98.312	1573
" soft wood	17.500	280
" triturated	86.250	1380
Cherry	44.687	715
" well seasoned	37.875	606
Chestnut, sweet	38.125	610
Citron	45.375	726
Cocoa	65.000	1040

Weight and Specific Gravity—Continued.

Woods, Dry.	Weight of a cubic foot in pounds, avoirdupois.	Specific gravity pure water = 1.	Woods, Dry.	Weight of a cubic foot in pounds, avoirdupois.	Specific gravity pure water = 1.
Cork	15.000	240	Oak, African	51.437	823
Cypress, Spanish	40.250	644	" Canadian	54.500	872
" well seasoned	27.562	441	" Dantzic	47.437	759
Dogwood	47.250	756	" English	58.250	932
Ebony, American	83.187	1331	" green	71.625	1146
" Indian	75.562	1209	" heart, 60 years	73.125	1170
Elder	43.437	695	" live, green	78,750	1260
Elm	35.625 41.937	570 671	" " seasoned " white	66.750 53.750	1068 860
Filbert	37.500	600	" " well seasoned	42.937	687
Fir (Norway spruce)	32.000	512	" " James R., well		
Gum, blue	52.687	843	seasoned	42.437	759
" water	62.500	1000	Orange	44.062	705
Hackmatack	37.000	592	Pear	41.312	661
Hazel	53.750	860	Persimmon	44.375	710
Hawthorn	56.875	910	Pine, pitch	41.250	660
Hemlock	23.000	368	" red	36.875	590
Hickory, pig nut	49.500	792	" white	34.625	554
" red, well seasoned	52.375	838	" " well seasoned.	29.562	473
" shell bark	43.125	690	" yellow "	33.812	541
Holly	47.500	760	" " dry	28.812	461
Jasmine	48.125	770	Plum	49.062	785
Juniper	35.375	566	Pomegranate	84,625	1354
Lancewood	45.000	720	Poon	36.250	580
Larch	34.000 35.000	544 560	Poplar " white	23.937 33.062	383 529
Lemon	43.937	703	Quince	44.062	705
Lignum-vitæ	83.312	1333	Rosewood	45.500	728
Lime	50.250	804	Sassafras	30.125	482
Linden	37.750	604	Satinwood	55.312	885
Locust	45.500	728	Spruce	31.250	500
Logwood	57.062	913	Sycamore	38.937	623
Mahogany	45.000 66.437	720 1063	Tamarack	23.937	383
" Honduras	35.000	560	Teak African oak	41.062 46.562	657 745
" Spanish	53.250	852	Walnut	41.937	671
" St. Domingo, extra dry	45.000	720	black	31.250	500
Maple	46.875	750	Willow	30.375 36.562	486 585
" bird's-eye	36.000	576	Yew, Dutch	49.250	788
Mastic	53 062	849	" Spanish	50.437	807
Mulberry	35.062 56.062	561 897			

Railroad Ties.—Prof. Sargent states that the Railroads of the United States, old and new, consume every year not far from 60,000,000 ties, destroying 30,000,000 vigorous, healthy young trees; upon the supposition that two ties are cut from a tree. The value of Railroad ties put down by completed roads in 1880, (not counting 10,000 miles in course of construction) amounted to nearly $10,000,000. Ties are made chiefly from oak, hemlock and red-elm.

Telegraph Poles.—These are cut from white-cedar, red-cedar, white-ash, redwood, oak, and sometimes other woods. It is claimed that Chicago, Ill., furnishes one-third of all the telegraph poles used in the United States, one-ninth of all the Railroad ties, and 5 per cent. of the posts, supplying Railroad and telegraph lines from New York to Utah, southwest as far as Arizona, besides sending some poles to Mexico. No pine is used for poles. Average duration of posts and poles, is from 8 to 12 years, white-cedar lasting about 8, and oak about 12 years.

BOILING POINTS OF MISCELLANEOUS SUBSTANCES.

(Under One Atmosphere,) Degrees Fahrenheit.

SUBSTANCES.	DEGREE.	SUBSTANCES.	DEGREE.	SUBSTANCES.	DEGREE.
Acetate of Soda..	255.8	Linseed Oil......	597	Salt, common....	227 2
" " Potash	336.	Mercury........	648.	SeaWater aver'ge	213 2
Alcohol, s. g. 813.	173.	Milk..............	213.	Sulphur.........	570.
Ammonia........	140.	Naphtha.........	186.	Sulphuric Acid, s. g., 1.848.	590.
Benzine..........	173.	Nitrate of Soda..	250.	Sulp. Acid s.g. 1.3	240.
Brine............	226.	Nitrate of Potash	240.6	Sulphuric Ether.	100.
Carbonate of Soda	220.3	Nit. Acid, s. g. 1.42	248.	Turpentine......	315.
Carb. of Potash..	275.	Nit. Acid, s. g. 1.5	210.	**Water**.........	212.
Chloroform......	146.	Oil of Turpentine	315.	Water, in *vacuo*..	98.
Coal Tar.........	325.	Petroleum rectf'd	316.	Whale Oil......	630.
Ether	100.	Phosphorus......	554.		

NOTE.—Water may be heated in a Digester to 400° without boiling. Fluids boil in a vacuum with less heat than under pressure of atmosphere. Water may be reduced to 5° if confined in tubes of from .003 to .005 inch in diameter; this is in consequence of adhesion of water to surface of tube, interfering with a change in its state. It may also be reduced in its temperature below 32° if it is kept perfectly quiescent.

BOILING POINT OF PURE WATER AT DIFFERENT ALTITUDES.

Boiling Point at the Level of the Sea—212° Fahr.

Degree.	Feet.	Degree.	Feet.	Degree.	Feet.	Degree.	Feet.	Degree.	Feet.
215	*1,551	202	5,300	189	12,489	176	20,016	163	27,881
214	*1,036	201	5,841	188	13,056	175	20,609	162	28,500
213	* 519	200	6,384	187	13,625	174	21,204	161	29,121
212	0	199	6,929	186	14,196	173	21,801	160	29,744
211	521	198	7,476	185	14,769	172	22,400	159	30,369
210	1,044	197	8,025	184	15,344	171	23,001	158	30,996
209	1,569	196	8,576	183	15,921	170	23,604	157	31,625
208	2,096	195	9,129	182	16,500	169	24,209	156	32,256
207	2,625	194	9,684	181	17,081	168	24,816	155	32,889
206	3,156	193	10,241	180	17,664	167	25,425	154	33,524
205	3,689	192	10,800	179	18,249	166	26,036	153	34,161
204	4,224	191	11,361	178	18,836	165	26,649	152	34,800
203	4,761	190	11,924	177	19,425	164	27,264	150	36,084

*** Feet below the sea level.**

Transmission of Heat Through Glass of Different Colors.—Direct—100.

Plate	65.5	Window	52.	Yellow	40.
Red	53.	Orange	44.	Green	26.
Violet, deep	53.	Blue, light	42.	Blue, deep	19.

Melting Points of Metals and Various Substances.

Metals.	Deg.
Aluminum at red heat	......
Antimony	810
Arsenic	365
Bismuth	476
Bronze	1692
Calcium, at red heat	......
Copper	1996
Gold, pure	2282 / 2590
Gold, standard	2156
Iron, cast	2250 / 3479*
" 2d melting	2450 / 3700*
" wrought	2912 / 3509*
Lead	608
Lithium	356
Mercury	39
Nickel, highest forge heat	......

Metals.	Deg.
Platinum	3080
Potassium	136
Silver	1250 / 1873
Sodium	194
Steel	2500
Tin	446
Zinc	680
Alloys.	
Lead 2, Tin 3, Bis. 5	212
" 1, " 3, " 5	210
" 1, " 4, " 5	240
" 3, " 2, " 5	199
" 2, " 3	334
" 3, " 1	552
" 2, " 1 solder	475
" 1, " 2 soft "	360
" 1, " 1	368
Tin 1, Bismuth 1	286
" 2, " 1	336
" 8, " 1	392
Zinc 1, Tin 1	399

Fusible Plugs.	Deg
Lead 2, Tin 2	372
" 6, " 2	383
" 7, " 2	388
" 8, " 2	410
Miscellaneous.	
Ambergris	145
Beeswax	151
Carbonic Acid	108
Glass	2377
Ice	32
Lard	95
Nitro-glycerine	45
Phosphorus	112
Pitch	91
Saltpetre	606
Spermaceti	112
Stearine	114
Sulphur	239
Tallow	92
Wax, white	142

* Rankine.

NOTE.—The volume of water, antimony and cast-iron in a solid state, exceeds that of the liquid, as evidenced by floating upon their own melted substances.

WEIGHT OF GASES.

Gases at 32° Fahr., and under one atmosphere. *Weight of a cubic foot* **in lbs., avoirdupois.**

NAMES.	Weight.	NAMES.	Weight.
Air	0.0753125	Hydrogen	0.005592
Bisulphuret-of-Carbon Vapor, (ideal)	0.2137	Nitrogen	0.078596
Carbonic Acid	0.12344	Olefiant Gas	0.0795
Ether Vapor (ideal)	0.2093	Oxygen	0.089256
		Steam, (ideal)	0.05022

SOUND.—The velocity of sound through the air in a temperature at 62° Fahrenheit is 1,125 feet per second.

The velocity of sound through water is 4½ times, through iron, 10 times, and through wood, from 11 to 17 times that in air.

DESCRIPTION OF SOUND.	Audible at a Distance of	
	FEET.	MILES.
A powerful human voice in the open air and no wind	460	.087
Beating of a drum	10,560	2
Music of a heavy brass band	15,840	3
Report of a musket	16,000	3.02
Cannonading, very strong	475,000	90

LIGHT.—The velocity of light is 192,500 miles per second. Estimating the distance to be 95,000,000 miles, it passes from the sun to the earth in 8.2 minutes. It can pass through the distance of the circumference of the earth in ⅛ of a second.

VELOCITY AND FORCE OF WIND.

WIND.—The velocity of air in passing into a vacuum is 1346.4 feet per second.

Description	Miles per Hour.	Feet per Minute.	Force in lbs. per Sq. Foot	Description.	Miles per Hour.	Feet per Minute.	Force in lbs. per Sq. Foot
Hardly percept.	1	88	.005	High wind	30 35	2,640 3,080	4.429 6.027
Just perceptible	2 3	176 264	.020 .044	Very high wind	40 45	3,520 3,960	7.873 9.963
Gentle breeze	4 5	352 440	.079 .123	Storm	50 55	4,400 4,840	12.300 14.883
Pleasant breeze.	6 9	528 792	.177 .400	Great storm	60 65	5,280 5,720	17.712 20.787
Brisk gale	10 15	880 1,320	.492 1.107	Hurricane	70 85	6,160 7,480	24.108 35.547
Very brisk gale.	20 25	1,760 2,200	1.968 3.075	Tornado	100	8,800	49.200

PRESSURE OF LIQUIDS OR INELASTIC FLUIDS.

1. The area (a) of the base of a regular vessel, the height (h) of the fluid in feet, and the weight (w) of a cubic foot of the fluid being given; required the pressure (p) in pounds on the bottom of the vessel:

$$a \times h \times w = p.$$

2. The height (h) of a column of fluid in feet, and the weight (w) of a cubic foot of the fluid being given; required the pressure (p) in pounds of the column per square inch:

$$h \times w \div 144 = p.$$

3. The diameter in feet of the base (b) of a cylindrical reservoir, and the depth in feet (d) of fresh water contained therein being given; required the pressure (p) in pounds upon the staves:

$$b \times 3.1416 \times d \times (d \div 2) \times 62.5 = p.$$

WEIGHTS AND MEASUREMENTS OF WATER.

The constitution of fresh water is—

Oxygen, by weight, 88.889; by measure, 1
Hydrogen, " 11.111; " 2

A cubic foot of water weighs 998.06512 ounces, or 62.37907 lbs. avoirdupois.

For convenience of computation the weight of a cubic foot of water is taken at 1000 ounces, or 62.5 lbs.

A cubic foot is to a cylindrical foot as 1 is to .7854.

1	cubic foot of water	=	62.5 pounds.
1	cylindrical foot of water	=	49.1 "
1	gallon of water	=	8.33 "
12	gallons of water	=	1 cwt. (100 lbs.)
13.44	gallons of water	=	1 " (112 ")
240	gallons of water	=	1 ton (2000 ")
268.8	gallons of water	=	1 " (2240 ")
1.6	cubic foot of water	=	1 cwt. (100 ")
1.8	cubic foot of water		1 " (112 ")
32	cubic feet of water	=	1 ton (2000 ")
35.84	cubic feet of water	=	1 " (2240 ")
1	cubic foot of water	=	7.5 gallons.
1	cylindrical foot of water	=	5.9 "

PROPERTIES OF WATER.

Water vaporizes at all temperatures, even when in the form of ice.

As found in nature it is never pure, being always contaminated with foreign matter. Rain is the purest form of natural water, but always contains carbonic acid, and carbonate and nitrate of ammonia and other constituents, depending upon the locality in which it falls.

At a temperature of 212° Fahrenheit, with a barometric pressure of 29.92 inches, water boils and is converted into an invisible elastic vapor occupying 1,696 times its space.

As the temperature of water decreases it regularly contracts until cooled down to 39.2° Fahrenheit; but every decrease in temperature below this causes it to expand to almost the same extent for each degree as it had previously contracted.
In freezing, water expands .076 of its bulk.

A cubic foot of water weighs 62.5 lbs.
" " ice " 58.08 "
35.84 cubic feet of water weigh a ton (2240 lbs.)
38.57 " " ice " " "

The weight of sea water is 1.029 times that of fresh water. One cubic foot of sea water weighs 64.3125 pounds, and one gallon 8.58 pounds. About one thirty-third part of its weight, or four ounces to each gallon, is salt.

PROPOSITIONS AND FORMULAS.

1. The length (l) width (w) and depth (d) in inches of a quadrilateral cistern being given; required its capacity in gallons (g):

$$l \times w \times d \div 231 = g.$$

2. The diameter (d) and depth (h) in inches of a circular cistern of uniform diameter being given required its capacity in gallons (g):

$$d^2 \times .7854 \times h \div 231 = g.$$

3. The lower diameter (D) the upper diameter (d) and the depth (h) in inches of a circular cistern of different diameters being given; required its capacity in gallons (g):

$$D^2 + d^2 + (D \times d) \times .7854 \times h \div 693 = g$$

That of formula 2 has the form of a cylinder; that of formula 3 the form of a frustrum of a cone.

HYDRAULICS.

Gravity is the fundamental principal in Hydraulics. Descending Fluids are actuated by the same laws as *Falling Bodies*. A Fluid will fall through 1 foot in one-quarter of a second, 4 feet in one-half of a second, and through 9 feet in three-quarters of a second, and so on.

The velocity of a stream of water, flowing from an aperture in the side or bottom of a vessel, reservoir, or bulkhead, that is kept full, is the same that a heavy body would acquire by falling freely from a height equal to that between the surface of the fluid and the middle of the aperture; the distance between these levels is termed the head. The velocity of water flowing out of an aperture is as the square root of the height of the head of the fluid. The *Theoretical* velocity, therefore, in feet per second, is as the square root of the product of the space fallen through in feet and 64.333; consequently, for 1 foot it is $\sqrt{64.333} = 8.02$ *feet*. The *Mean* velocity, however, of a number of experiments gives 5.4 feet or .673.

Contracted Vein.—The vein or stream begins to contract at the outlet, and continues contracting for a distance equal to nearly three (3) times the diameter of the opening. At the point of greatest contraction its velocity is nearly equal to theoretical velocity. This contraction differs according to the conditions imposed. Thus the stream flowing from a thin-lipped orifice, under ordinary circumstances, becomes, on an average, contracted about 38 per cent. But the stream flowing from a smooth nozzle, with opposite sides including an angle of 16 degrees, the contraction amounts to about 2½ per cent.

Measurement of Water.—In Southern Cal. the flow of 1-50th of a cubic foot of water per second, is an inch.

A **Miner's Inch** of water, legal measure, in the State of California, (*see Water Rights, State of California, Civil Code, Section* 1415) is that quantity of water which will flow through an opening of one square inch in the bottom or side of a vessel, under a pressure of four inches above the opening. **Fifty** of the above "Miners' Inches" is equivalent to the discharge of one cubic foot of water per second, and is less by **.312** of a cubic foot per second than the "Nevada County Miner's Inch." (*See Miner's Inch Illustrated, in another part of this work.*)

The above-mentioned act was amended in 1903 so as to read: "Each square inch of the opening represents a miners' inch, and is equal to a flow of 1½ cubic feet of water per minute

Gallons in Miners' Inches.—Multiply the given number of "Miners' Inches" by 14.961, pointing off five decimal places; the result gives the number of gallons discharged per second.

Miners' Inches in Gallons. —Divide the number of gallons, flow or discharged per minute, by 8.9766; result will be the number of Miners' Inches sought.

Velocity of Water through Clean Iron Pipe.—Eleven (11) times the number of Miners' Inches flow, divided by three (3) times the square of the diameter of the pipe, is equal to the velocity of the water in the pipe per second.

EXAMPLE.—The flow of water in a pipe 30 inches in diameter, with 9 feet fall to the mile, is 960 miners' inches. What is the velocity per second? *Solution*:— Pipe, 30 X 30 = 900 X 3 = 2,700; Miners' Inches, 960 X 11 = 10,560 ÷ 2,700 = 3.91 feet per second velocity sought.

NOTE.—The carrying capacity of clean iron pipe is represented by the unit (1); that of slightly rough iron pipe is .89 per cent. of that of a clean pipe; and that of very rough iron pipe is .77 per cent. of that of clean pipe.

To ascertain the number of Miners' Inches of Water that will flow through Clean Iron Pipe, the velocity of the water, and the diameter of pipe being known.

Three (3) times the product of the velocity of the water, and the square of the diameter, divided by 11 is equal to the Miners' Inches flow.

EXAMPLE.—The velocity of water in a pipe 22 inches diameter is 5 feet per second; required the number of Miners' Inches? *Solution:* 22 X 22 = 484 X 5 = 2,420 X 3 = 7,260 ÷ 11 = 660 the number of Miners' Inches sought.

Useful Facts in Hydraulics.—Doubling the diameter of a pipe increases the capacity four times.

Circular apertures are most effective for discharging water, since they have less frictional surface for the same area.

To find the pressure in pounds per square inch of a column of water, multiply the height of the column in feet by .434. (Approximately every foot of elevation is considered equal to ½ lb. pressure per square inch.)

The time occupied in discharging equal quantities of water, under equal heads, through pipes of equal lengths, will be different for varying forms, and proportionally as follows: For a *straight line*, 90; for a *true curve*, 100; and for a *right angle*, 140.

The quantities of water discharged in the same time, through different sized apertures, under different heads, are to one another in the compound ratio of areas of the apertures, and of the square roots of the heights of heads above the centers of the apertures.

HYDRAULICS.—Continued.

Measurement of Flowing Water in Ditches, Canals, Rivers, &c.—To measure the water flowing in a ditch or small stream; first select a position along such ditch or stream, so that a small weir dam constructed across it at a right angle (of a single 2-inch plank set up edgeways) would create an eddy from 75 to 100 feet above the same; cut a notch in the plank, sufficient in depth to pass all the water to be measured, and not more than two-thirds of the width of the stream in length; have the upper side of the plank lined with sheet-iron, and the sides and bottom of the notch chamfered on the lower side to an angle of about 45 degrees. Let this dam be so situated, that all the water passing over it will fall clear at least 10 inches, and run away unobstructed; next drive a stake in the stream (about one-third the way across, and 10 feet above the dam) down to the true level of the bottom of the notch in the plank forming the weir dam After the water has come to a stand, and reached its greatest depth, a careful measurement can be made of the depth of the water over the top of the stake, which gives the true depth of the water passing over the notch; multiply the breadth of the water passing over the weir by the depth over the stake, and the product is the area. Multiply the area by the *mean* velocity of its flow in feet per second, and the product is the volume in cubic feet; divide the number of cubic feet by **1.57**, and the result will be the number of Miners' Inches.

EXAMPLE.—A stream of water 90 inches wide running over a weir dam (as above defined), and 9 inches deep over the stake, with a mean velocity of 5 feet per second; required the cubic feet and Miners' Inches of water? *Solution:* $90 \times 9 \times 5 = 4{,}050$ cubic feet; $4{,}050 \div 1.57 = 2{,}579.62$ Miners' Inches.

The velocity of such a stream can be estimated by throwing floating bodies on the surface of near the same specific gravity as the water, and rating the time accurately, required in passing a given distance. The velocity is greatest in the center of the stream and near the surface, and is less near the bottom and side. Reliable experiments prove the *Mean* velocity to be .83 per cent. of the velocity of the surface in the center of the stream.

To Compute the Mean Depth of Flowing Water in Large Streams.—RULE: Set off the breadth of the stream, etc., into any convenient number of divisions; ascertain the mean depths of these divisions, then divide their sum by the number of divisions, and the quotient is the mean depth.

To Compute the Mean Area of Flowing Water.—RULE: 1. Multiply the breadth or breadths of the stream, etc., by the mean depth or depths, and the product is the area. 2.—Divide the volume flowing in cubic feet per second by the mean velocity in feet per second, and the quotient is the area in square feet.

To Compute the Volume of Flowing Water.—RULE: Multiply the area of the stream, etc., by the mean velocity of its flow in feet, and the product is the volume in cubic feet.

To Compute the Mean Velocity of Flowing Water.—RULE: Divide the velocity of the flow in feet per second by the area of the stream, etc., and the quotient will give the velocity in feet. The mean velocity at half depth of a stream has been ascertained to be as .915 to 1, and at the bottom of it as .83 to 1, compared with the velocity at the surface.

Friction of Water upon a Plane Surface.—By the experiments of Beaufoy, it was ascertained that the friction increased *very nearly* as the square of the velocity, and that a surface of 50 square feet, at a velocity of 6 feet per second, presented a resistance of 6 lbs. Hence $50 \div 6 = 8.33$ square feet $= 1$ lb. resistance at a velocity of 6 feet; and, consequently, $1 \div 8.33 = .12$ lbs. resistance per square foot at the same velocity.

Friction in Pipes.—The *Resistance of Friction* in the flow of water through pipes, etc., of a uniform diameter, is independent of the pressure, and increases directly as the length, very nearly as the square of the velocity of the flow, and inversely as the diameter of the pipe. With wooden pipes the friction is 1.75 times greater than in metallic.

Water and Steam Pistons.—The area of the water piston, multiplied by the pressure of water per square inch, gives the resistance. The area of the steam piston, multiplied by the steam pressure, gives the total amount of pressure exerted. A margin must be made between the power and the resistance to move the pistons at the required speed.

To Compute the Horse-power necessary to Raise Water to any given Elevation.—RULE: Multiply the weight of the column of the water by its velocity in feet per minute, and divide the product by 33,000.

EXAMPLE.—It is required to raise 1,000 gallons of fresh water per minute, to an elevation of 140 feet, through a cast-iron pipe 560 feet in length; what is the required power? *Solution*: 1,000 gallons of fresh water $= 1{,}000 \times 231 = 231{,}000$ *cubic inches*, and $231{,}000 \div 1{,}728 = 133.68$ *cubic feet per minute*. Hence, $133.68 \times 62.5 \times 140 \div 33{,}000 = 35.44$ *horse-power*.

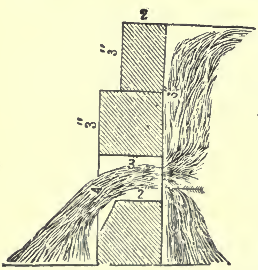
WATER MEASUREMENT in the State of Cal. by 11 Different Ditch Co's; Legal Measurement of the State Included.

NAME OF DITCH CO., ETC.	OPENING. Dep'h in.	OPENING. Wdth in.	Through a Plank, inches.	PRESSURE BOARD Above open'ng inches.	PRESSURE BOARD Above centre open'ng inches.	Miner's Inch.	Cu'ic feet per min.
State of Cal. (legal measure)	†	†	†	†	†	= 1	1.50
Amador Canal Co..........	2	½	1	4	6	= 1	1.40
Eureka Lake and Canal Co.	2	½	1½	5	6	= 1	1.45
Park Canal and Mining Co.	2	½	1½	5	6	= 1	1.45
El Dorado Water & D G M Co	4	¼	1	4	6	= 1	1.45
Mok & Campo Seco C & M Co	4	¼	1½	3	5	= 1	1.40
Union Water Co., Murphys.	4	¼	1	4	6	= 1	1.45
South Yuba Canal Co......	4	¼	1	4	6	= 1	1.45
N. Bloomfield B. G. M. Co.	2	½	* 3	6	7	= 1	1.575
Milton Ditch Co...........	2	½	* 3	6	7	= 1	1.575
La Grange Ditch Co.......	2	½	* 3	6	7	= 1	1.575
Smartsville Ditch Co.......	4	¼	2	7	9	= 1	1.78

NOTE.—To measure any desired number of inches of water by the above table (by the standard of any one of the companies), increase the opening in the 2d column (headed width inches) to a number—which multiplied by the figure in the 1st column will make the number of inches desired. *Thus:*—Union Water Co., Murphys—For 100 inches of water, 2d column 25x4 (in 1st column) = 100 inches = 145.00 cubic feet of water.

It will be seen by reference to the above table that the Smartsville Ditch Co. furnish 26½ per cent. more water (for the number of inches sold) than the Amador Canal Co. * Last inch chamfered. † See Index, A miners' inch.

Illustrated Measurement of Miners' Inches of Water.



The size of the opening was taken with a measure (micrometer attached) which had been compared with and adjusted to a standard U. S. yard. Time was read to one-fifth of a second. The level of the water (drawn from a large reservoir) was determined with Boyden's hooks, micrometer adjustment. The following results were obtained:

				Cubic Feet.
1 miners' inch will discharge in 1 sec.				.026
"	"	"	1 min.	1.57
"	"	"	1 hour	94.2
"	"	"	24 hours	2260.8

Ratio of actual to theoretical discharge, 61.6 per cent. These figures are within the limits of 1-500 possible error. Experiments were made by Hamilton Smith, Jr., of North Bloomfield, Calif.

A series of experiments made at La Grange, to determine the effective value of the above described inch, gave the following results:

1 miners' inch discharged in		1 second	.02499	cubic feet.
"	"	1 minute	1.4994	"
"	"	1 hour	89.9640	"
"	"	24 hours	2159.1460	"

Ratio of effective to theoretical discharge, 59.05 per cent. These results are the average of a series of experiments by **August J. Bowie, Jr., of San Francisco,** to whom we are indebted for the facts.

POWER.—The units of *force, distance* and *time,* are respectively 1 pound, 1 foot and 1 minute.

Man Power.—One man's power=.0909 horse power=3,000 units of work=3,000 pounds raised vertically 1 foot in 1 minute, or its equivalent.

Horse Power.—One horse power=11 men's power=33,000 units of work=33,000 pounds raised vertically 1 foot in 1 minute, or its equivalent.

ATMOSPHERIC WEIGHT.—In whole numbers the atmospheric pressure per square inch is 15 pounds.

Atmospheric Air.—A column, 1 inch square, full height=14.73 pounds.

Mercury.—A column, 1 inch square, and 30 inches high=14.73 pounds.

Fresh Water.—A column, 1 inch square, and 33.95 feet high=14.73 pounds.

Salt Water.—A column, 1 inch square, and 33.05 feet high=14.73 pounds.

Miners' Inches of Water.

The following table shows the discharge in cubic feet per minute, of a miner's inch of water, as measured under the various heads and different lengths and heights of apertures used in California, the result of a series of very careful experiments made (in 1887) by W. F. Englebright, C. E. and L. A. Pelton, Hy. E. at Nevada City, Cal. The apertures were through material 1½ inch thick and their lower edge 2 inches above the bottom of the measuring box, thus giving full contraction.

Length of Opening in Inches.	HEIGHT OF OPENING 2 INCHES.			HEIGHT OF OPENING 4 INCHES.		
	HEAD TO CENTER OF OPENING.			HEAD TO CENTER OF OPENING.		
	5 Inches.	6 Inches.	7 inches.	5 Inches.	6 Inches.	7 Inches.
	Cubic Feet.	Cubic Feet.	Cubic Feet.	Cubic Feet.	Cubic Feet.	Cubic Feet
4	1.348	1.473	1.589	1.320	1.450	1.570
6	1.355	1.480	1.596	1.336	1.470	1.595
8	1.359	1.484	1.600	1.344	1.481	1.608
10	1.361	1.485	1.602	1.349	1.487	1.615
12	1.363	1.487	1.604	1.352	1.491	1.620
14	1.364	1.488	1.604	1.354	1.494	1.623
16	1.365	1.489	1.605	1.356	1.496	1.626
18	1.365	1.489	1.606	1.357	1.498	1.628
20	1.365	1.490	1.606	1.359	1.499	1.630
22	1.366	1.490	1.607	1.359	1.500	1.631
24	1.366	1.490	1.607	1.360	1.501	1.632
26	1.366	1.490	1.607	1.361	1.502	1.633
28	1.367	1.491	1.607	1.361	1.503	1.634
30	1.367	1.491	1.608	1.362	1.503	1.635
40	1.367	1.492	1.608	1.363	1.505	1.637
50	1.368	1.493	1.609	1.364	1.507	1.639
60	1.368	1.493	1.609	1.365	1.508	1.640
70	1.368	1.493	1.609	1.365	1.508	1.641
80	1.368	1.493	1.609	1.366	1.509	1.641
90	1.369	1.493	1.610	1.366	1.509	1.641
100	1.369	1.494	1.610	1.366	1.509	1.642

Horse-Power of Pulleys and Belts.

EXPLANATION.—Multiply the horse-power found opposite any given pulley by the revolutions it is to make; this product multiplied by width of belt in inches, gives the horse-power they will transmit.

Diameter of Pull'y in in.	*Horse Power.	Diameter of Pull'y in in.	*Horse Power.	Diameter of Pull'y in in.	*Horse Power.	Diameter of Pull'y in in.	*Horse Power.
2	.00066	29	.00949	56	.01832	83	.02715
3	.00098	30	.00982	57	.01865	84	.02748
4	.00131	31	.01014	58	.01898	85	.02781
5	.00164	32	.01046	59	.01931	86	.02814
6	.00196	33	.01079	60	.01964	87	.02847
7	.00229	34	.01112	61	.01997	88	.02880
8	.00262	35	.01145	62	.02028	89	.02913
9	.00294	36	.01178	63	.02061	90	.02946
10	.00327	37	.01211	64	.02092	91	.02979
11	.00360	38	.01242	65	.02125	92	.03012
12	.00392	39	.01275	66	.02158	93	.03045
13	.00425	40	.01308	67	.02191	94	.03076
14	.00458	41	.01341	68	.02224	95	.03109
15	.00491	42	.01374	69	.02257	96	.03140
16	.00523	43	.01407	70	.02290	97	.03173
17	.00556	44	.01440	71	.02323	98	.03206
18	.00589	45	.01473	72	.02356	99	.03239
19	.00621	46	.01506	73	.02389	100	.03272
20	.00654	47	.01538	74	.02422	101	.03305
21	.00687	48	.01570	75	.02455	102	.03338
22	.00720	49	.01603	76	.02488	103	.03371
23	.00752	50	.01636	77	.02521	104	.03403
24	.00785	51	.01669	78	.02550	105	.03436
25	.00818	52	.01701	79	.02583	106	.03468
26	.00850	53	.01734	80	.02616	107	.03501
27	.00883	54	.01766	81	.02649	108	.03533
23	.00916	55	.01799	82	.02682	109	.03566

* Horse-power for one revolution per minute for a belt one inch wide.

FLOW OF WATER THROUGH NOZZLES,

At Various Pressures, from 1 to 1,000 Feet. Velocity, Cubic Feet and Miners' Inches of Water and Horse-Power Obtained.

Head of Water Feet.	Velocity per Second Feet	Diameter of Nozzles. 1 Inch. Cubic Feet.	Min'rs Ins	Horse-Power.	1½ Inch. Cubic Feet.	Min'rs Ins.	Horse-Power.	2 Inches. Cubic Feet.	Min'rs Ins.	Horse-Power.	2½ Inches. Cubic Feet.	Min'rs Ins.	Horse Power.
1.	8.02	.041	2.05	.004	.093	4.6	.010	.164	8.2	.018	.255	12.7	.029
1.5	9.83	.050	2.43	.008	.111	5.5	.019	.200	9.7	.034	.312	15.2	.053
2.	11.35	.058	2.81	.013	.130	6.3	.029	.232	11.2	.052	.360	17.6	.082
2.5	12.68	.064	3.20	.018	.145	7.2	.041	.256	12.8	.072	.402	20.1	.114
3.	13.90	.069	3.32	.024	.159	7.8	.054	.284	13.9	.096	.440	21.7	.150
3.5	15.01	.076	3.61	.030	.171	8.4	.068	.304	15.0	.120	.475	23.4	.189
4.	16.05	.081	3.92	.037	.183	9.0	.083	.324	16.1	.148	.507	25.0	.231
4.5	17.02	.086	4.22	.044	.194	9.6	.099	.344	17.2	.176	.540	26.7	.275
5.	17.95	.091	4.50	.051	.205	10.2	.113	.364	18.2	.204	.567	28.3	.315
6.	19.66	.100	4.90	.068	.224	11.0	.153	.400	19.7	.272	.622	30.7	.425
7.	21.23	.108	5.30	.086	.242	11.9	.193	.432	21.3	.344	.672	33.0	.535
8.	22.70	.116	5.70	.104	.260	12.7	.252	.464	22.9	.416	.720	35.4	.656
9.	24.08	.123	6.10	.125	.275	13.6	.290	.490	24.5	.500	.765	37.8	.782
10.	25.38	.129	6 50	.146	.290	14.5	.329	.516	25.8	.584	.805	40.2	.915
12.5	28.37	.144	7.21	.204	.324	16.1	.460	.576	28.6	.816	.897	44.7	1.28
15.	31.08	.158	7.90	.269	.355	17.7	.505	.632	31.6	1.08	.985	49.2	1.68
17.5	33.57	170	8.52	.339	.383	19.1	.782	.680	34.0	1.36	1.06	53.1	2.11
20.	35.89	.182	9.10	.414	.410	20.5	.931	.728	36.4	1.66	1.14	57.0	2.58
22.5	38.07	.193	9.65	.494	.435	21.7	1.11	.772	38.6	1.98	1.21	60.0	3.08
25.	40.13	.204	10.20	.578	.458	22.9	1.30	.816	40.8	2.31	1.27	63.0	3.61
27.5	42.08	.313	10.81	.667	.480	24.2	1.50	.852	43.2	2.67	1.33	67.0	4.17
30.	43.95	.228	11.4	.760	513	25.6	1.71	.912	45.6	3.04	1.42	71.0	4.75
32.5	45.75	.232	11.7	.857	.522	26.3	1.93	.928	46.9	3.43	1.45	73.0	5.35
35.	47.47	.241	12.0	.958	.542	27.1	2.15	.964	48.2	3.83	1.51	75.0	5.98
40.	50.75	.257	12.8	1.17	.579	29.0	2.63	1.03	51.0	4.68	1.61	80.0	7.31
45.	53.83	.273	13.6	1.40	.614	30.7	3.14	1.09	54.0	5.60	1.71	85.0	8.23
50.	56.75	.288	14.4	1.64	.648	32.4	3.68	1.15	57.0	6.56	1.79	90.0	10.2
60.	62.16	.315	16.7	2.15	.709	35.4	4.84	1.26	63.0	8.60	1.97	98.0	13.4
70.	67.14	.341	17.0	2.71	.766	38.3	6.10	1.36	68.0	10.8	2.13	106.0	16.9
80.	71.78	.364	18.2	3.31	.819	40.9	7.45	1.46	73.0	13.2	2.27	113.0	20.6
90.	76.13	.386	19.3	3.95	.864	43.2	8.88	1.54	77.0	15.8	2.44	122.0	24.6
100.	80.25	.407	20.3	4.63	.916	45.8	10.4	1.63	81.0	18.5	2.54	127.0	28.9
125.	89.72	.455	22.7	6.47	1.02	51.0	14.5	1.82	91.0	25.8	2.84	142.0	40.4
150.	98.28	.499	25.0	8.50	1.12	56.0	19.1	2.00	100.0	34.0	3.11	155.0	53.1
175.	106.10	.539	26.9	10.7	1.21	60.0	24.0	2.16	108.0	42.8	3.36	168.0	66.8
200.	113.50	.576	28.8	13.1	1.29	64.0	29.4	2.30	115.0	52.4	3.59	179.0	81.7
250.	127.1	.644	32.2	18.3	1.45	72.0	41.1	2.58	129.0	73.2	4.02	201.0	114.0
300.	139.0	.705	35.2	24.0	1.59	79.0	54.0	2.82	141.0	96.0	4.40	220.0	150.0
350.	150.1	.762	38.1	30.3	1.71	85.0	68.1	3.05	152.0	121.0	4.76	238.0	189.0
400.	160.5	.814	40 7	37.0	1.83	91.0	83.2	3.26	163.0	148.0	5.09	254.0	231.0
450.	170.2	.864	43.2	44.2	1.94	97.0	99.3	3.46	173.0	176.0	5.40	270.0	276.0
500.	179.4	.910	45	51.7	2.05	102.0	116.0	3.64	182.0	206.0	5.69	284.0	323.0
550.	188.2	.955	47 7	59.7	2.10	105.0	134.0	3.82	191.0	238.0	5.96	298.0	372.0
600.	196.6	.999	50.0	68.0	2.23	111 0	152.0	3.99	200.0	272.0	6.23	311.0	475.0
700.	212.3	1.06	53.0	85.7	2.46	123 0	192.0	4.36	218.0	242.0	6.79	339.0	535.0
800.	226.9	1.15	57.5	104.7	2.58	129.0	235.0	4.60	230.0	418.0	7.19	359.0	654.0
900.	240.7	1.22	61.0	124.9	2.75	137.0	281.0	4.88	244.0	499.0	7.63	381.0	780.0
1000.	253.8	1.29	64.5	146.2	2.89	144.0	329.0	5.16	258.0	584.0	8.04	402.0	914.0

Head of Water. Feet.	Velocity per Second. Feet.	Diameter of Nozzles. 3 Inches. Cubic Feet.	Min'rs Ins.	Horse-Power.	3½ Inches. Cubic Feet.	Min'rs Ins.	Horse-Power.	4 Inches. Cubic Feet.	Min'rs Ins.	Horse-Power.	4½ Ins. Min'rs Ins.	Horse-Power.
1.	8.02	.372	18.6	.040	.50	25.0	.056	.656	33.0	.072	40.6	.090
1.5	9.83	.444	22.1	.076	.61	29.7	.105	.800	39.0	.136	48.3	.183
2.	11.35	.520	25.5	.116	.70	34.3	.160	.928	45.0	.208	56.6	.277
2.5	12.68	.589	29.0	.164	.79	39.0	.224	1.02	51.0	.288	65.0	.370
3.	13.90	.636	31.6	.216	.86	42.2	.295	1.14	55.4	.384	70.4	.500
3.5	15.01	.684	34.2	.272	.94	45.4	.370	1.22	59.8	.480	75.8	.630
4.	16.05	.742	36.8	.332	1.02	48.6	.452	1.30	64.2	.592	81.2	.760
4.5	17.02	.776	39.4	.396	1.06	51.8	.540	1.38	68.6	.704	86.6	.890
5.	17.95	.820	42.0	.452	1.11	55.0	.600	1.46	73.0	.816	92.0	1.020
6.	19.66	.896	45.2	.612	1.22	59.6	.833	1.60	80.0	1.09	99.6	1.41
7.	21.23	.968	48.4	.772	1.32	64.2	1.05	1.73	87.0	1.38	107.2	1.80
8.	22.70	1.04	51.6	.928	1.40	68.8	1.28	1.85	94.0	1.66	114.8	2.19
9.	24.04	1.10	54.8	1.124	1.48	73.4	1.53	2.01	101.0	2.00	122.4	2.58
10.	25.38	1.16	58.0	1.32	1.57	78.0	1.79	2.16	108.0	2.34	130.0	2.97
12.5	28.37	1.30	64.5	1.84	1.76	87.0	2.50	2.30	117.0	3.46	144.5	4.21
15.	31.08	1.42	71.0	2.42	1.93	96.0	3.29	2.53	126.0	4 32	159.0	5.44
17.5	33.57	1.53	76.5	3.13	2.08	103.5	4.20	2.72	135.5	5.44	171.5	6.90
20.	35.89	1.63	82.0	3.72	2.23	111.0	5.07	2.91	145.0	6.64	184.0	8.37

FLOW OF WATER THROUGH NOZZLES.—Continued.

Head of Water. Feet.	Velocity per Second Feet.	Diameter of Nozzles. 3 Inches. Cubic Feet.	3 Inches. Min'rs Ins.	3 Inches. Horse Power.	3½ Inches. Cubic Feet.	3½ Inches. Min'rs Ins.	3½ Inches. Horse-Power.	4 Inches. Cubic Feet.	4 Inches. Min'rs Ins.	4 Inches. Horse-Power.	4½ Ins. Min'rs Ins.	4½ Ins. Horse-Power.
22.5	38.07	1.74	86.5	4.44	2.36	119.	6.05	3.09	154.	7.92	195.	10.0
25.	40.13	1.83	91.0	5.20	2.54	127.	7.08	3.26	163.	9.24	206.	11.7
27.5	42.08	1.92	96.5	6.00	2.61	133.	8.17	3.41	172.	10.68	218.	13.5
30.	43.95	2.05	102.0	6.84	2.79	139.	9.31	3.65	182.	12.16	230.	15.4
32.5	45.75	2.09	105.	7.72	2.84	143.	10.50	3.71	187.	13.72	237.	17.3
35.	47.47	2.17	108.	8.60	2.95	147.	11.71	3.86	193.	15.32	244.	19.3
40.	50.75	2.32	116.	10.52	3.15	157.	14.33	4.12	206.	18.72	261.	23.7
45.	53.83	2.46	123.	12.56	3.34	167.	17.10	4.36	218.	22.40	277.	28.3
50.	56.75	2.59	129.	14.72	3.52	176.	20.03	4.60	230.	26.24	291.	32.1
60.	62.16	2.84	142.	19.36	3.86	193.	26.32	5.04	252.	34.40	319.	43.8
70.	67.14	3.06	153.	24.40	4.17	208.	33.17	5.42	271.	43.36	342.	54.9
80.	71.78	3.28	164.	29.80	4.46	223.	40.55	5.84	290.	52.96	369.	67.0
90.	76.13	3.46	173.	35.52	4.73	236.	48.37	6.16	308.	63.20	389.	79.9
100.	80.25	3.66	183.	41.64	4.98	249.	56.67	6.52	326.	74.08	411.	93.7
125.	89.72	4.08	204.	58.20	5.57	278.	79.20	7.28	364.	103.5	459	131.0
150.	98.28	4.48	224.	76.48	6.10	305.	104.10	8.00	400.	136.0	504.	172.0
175.	106.10	4.84	242.	96.28	6.60	330.	131.5	8.64	433.	171.2	544.	217.0
200.	113.5	5.10	255.	117.7	7.05	352.	160.2	9.20	462.	219.6	580.	262.0
250.	127.1	5.87	290.	164.5	7.68	394.	223.9	10.16	512.	292.8	652.	370.0
300.	139.0	6.36	318.	216.3	8.34	431.	294.3	11.12	560.	384.0	715.	487.0
350.	150.1	6.84	342.	272.6	8.98	461.	371.2	12.09	606.	484.8	769.	613.0
400.	160.5	7.30	366.	323.0	9.62	498.	453.2	13.05	650.	592.0	811.	749.0
450.	170.2	7.76	388.	397.4	10.30	529.	541.0	14.01	692.	707.2	861.	894.0
500.	179.4	8.20	410.	466.0	10.91	557.	627.0	14.97	732.	827.2	909.	1048.0
550.	188.2	8.60	431.	536.8	11.55	584.	731.0	15.93	770.	955.2	955.	1208.0
600.	196.6	9.04	451.	611.0	12.20	610.	832.7	16.90	806.	1088.0	999.	1376.0
700.	212.3	9.71	492.	771.2	13.10	665.	1051.0	17.40	874.	1371.0	1083.	1735.0
800.	226.9	10.38	516.	942.0	14.00	705.	1282.0	18.40	934.	1675.0	1159.	2119.0
900.	240.7	11.05	550.	1124.0	14.90	745.	1530.0	19.50	986.	1998.0	1231.	2520.0
1,000	253.8	11.72	578.	1316.0	15.80	788.	1791.0	20.60	1032.	2339.0	1300.	2961.0

Head of Water Feet.	Velocity per sec. Feet.	Diameter of Nozzles. 5 Inches. Mi'rs Ins.	5 Inches. Horse-Power.	5½ Ins. Mi'rs Ins.	5½ Ins. Horse-Power.	6 Inches. Mi'rs Ins.	6 Inches. Horse-Power.	7 Inches. Mi'rs Ins.	7 Inches. Horse-Power.	8 Inches. Mi'rs Ins.	8 Inches. Horse-Power.	9 Inches. Mi'rs Ins.	9 Inches. Horse-Power.
1.	8.02	51.	.116	61.	.140	74.	.180	100.	.236	131.	.288	167.	.36
2.5	12.68	80.	.457	97.	.553	116.	.656	157.	.896	204.	1.15	261.	1.48
5.	17.95	113.	1.26	137.	1.53	164.	1.81	220.	2.48	292.	3.26	369.	4.07
7.5	21.98	139.	2.38	171.	2.87	200.	3.42	270.	4.66	356.	6.08	450.	7.70
10.	25.38	161.	3.66	194.	4.42	232.	5.28	315.	7.16	432.	9.36	522.	11.90
12.5	28.23	179.	5.19	216.	6.27	258.	6.68	350	10.18	469.	13.33	580.	16.85
15.	31.08	197.	6.72	238.	8.13	284.	8.08	386.	13.20	506.	17.30	639.	21.80
17.5	33.49	212.	8.51	257.	10.32	306.	11.49	416.	16.75	544.	21.95	688.	27.65
20.	35.89	227.	10.30	275.	12.5	328.	14.90	446.	20.3	582.	26.6	738.	33.50
22.5	38.01	240.	12.35	292.	15.0	347.	17.85	474.	24.3	617.	31.8	780.	40.15
25.	40.13	254.	14.40	308.	17.5	366.	20.8	503.	28.3	653.	37.0	823.	46.8
27.5	42.04	269.	16.34	327.	20.3	388.	24.1	531.	32.8	691.	42.8	872.	54.2
30.	43.95	285.	19.00	345.	23.0	410.	27.4	559.	37.3	730.	48.6	922.	61.6
32.5	45.71	293.	24.25	354.	26.0	432.	30.4	574.	42.0	751.	54.9	949.	69.5
35.	47.47	301.	29.5	364.	29.0	454.	33.4	590.	46.8	772.	61.3	976.	77.4
40.	50.75	322.	33.8	389.	35.3	464.	42.1	630.	57.3	824.	74.9	1044.	94.7
45.	53.83	341.	38.0	413.	42.2	492.	50.2	669.	68.4	872.	89.6	1107.	113.0
50.	56.75	359.	42.2	435.	49.5	518.	58.9	705.	80.1	920.	105.0	1165	128.0
60.	62.16	394.	50.7	477.	65.0	568.	77.4	772.	105.0	1008.	138.0	1278.	174.0
70.	67.14	425.	59.1	515.	82.0	612.	97.6	804.	133.0	1084.	173.0	1377.	220.0
80.	71.78	455.	67.6	550.	100.0	656.	119.0	892.	162.0	1168.	212.0	1476.	268.0
90.	76.13	482.	76.2	579.	119.0	692.	142.0	941.	193.0	1232.	253.0	1557.	320.0
100.	80.25	508.	84.5	615.	140.0	732.	167.0	997.	227.0	1304.	296.0	1647.	375.0
125.	89.72	567.	95.7	688.	195.0	816.	233.0	1115.	317.0	1456.	414.0	1836.	524.0
150.	98.28	623.	127.0	754.	257.0	896.	306.0	1221.	416.0	1600.	554.0	2016.	688.0
175.	106.1	673.	148.0	764.	314.0	968.	385.0	1320.	524.0	1728.	682.0	2178.	866.0
200.	113.5	717.	160.0	875.	396.0	1032.	471.0	1410.	641.0	1840.	878.0	2322.	1059.0
250.	127.1	804.	211.0	973.	553.0	1160.	658.0	1577.	896.0	2064.	1171.0	2610.	1481.0
300.	139.0	881.	254.0	1016.	727.0	1272.	865.0	1727.	1177.0	2256.	1536.0	2862.	1947.0
350.	150.1	952.	297.0	1102.	916.0	1368.	1090.0	1866.	1485.0	2440.	1949.0	3078.	2453.0
400.	160.5	1017.	338.0	1231.	1179.0	1464.	1332.0	1994.	1813.0	2608.	2368.0	3294.	2997.0
450.	170.2	1079.	381.0	1306.	1335.0	1552.	1590.0	2115.	2104.0	2768.	2829.0	3492.	3577.0
500.	179.4	1137.	423.0	1377.	1565.0	1640.	1864.0	2200.	2508.0	2912.	3409.0	3690.	4194.0
550.	188.2	1193.	466.0	1444.	1805.0	1680.	2147.0	2239.	2923.0	3056.	3821.0	3780.	4831.0
600.	196.6	1246.	507.0	1508.	2056.0	1784.	2446.0	2443.	3331.0	3192.	4352.0	4014.	5504.0
700.	212.3	1359.	592.0	1644.	2391.0	1968.	3085.0	2663.	4203.0	3488.	5485.0	4428.	6941.3
800.	226.9	1438.	676.0	1746.	3166.0	2064.	3768.0	2820.	5129.0	3680.	6701.0	4640.	8478.0
900.	240.7	1526.	761.0	1847.	3778.0	2200.	4496.0	2991.	6120.0	3904.	9357.0	4950.	10116.0
1000.	253.8	1608.	845.0	1946.	4424.0	2312.	5264.0	3153.	7166.0	4128.	9994.0	5200.	11844.0

Hydraulic Pipe, Pressure It Will Stand with Safety.

NOTE.—No. of iron by Birmingham Gauge, thickness in inches.

HEAD IN FEET PIPE WILL STAND, DOUBLE RIVETED.

Diameter of Pipe in Inches.	No. 8. .165 in.	No. 9. .148 in.	No. 10. .134 in.	No. 11. .120 in.	No. 12. .109 in.	No. 14. .083 in.	No. 16. .065 in.	No. 18. .049 in.
5	2136	1927	1755	1474	1344	887	582	353
6	1799	1622	1475	1238	1128	743	487	296
7	1552	1400	1272	1067	972	640	419	254
8	1366	1230	1117	938	854	560	367	222
9	1221	1098	997	836	761	499	327	198
10	1102	991	900	754	687	450	295	178
11	1008	904	820	687	626	412	269	162
12	922	829	753	630	574	377	246	157
13	853	768	696	583	530	348	228	138
14	795	714	648	543	494	324	211	128
15	742	667	606	507	460	302	197	119
16	696	625	567	474	432	283	185	
18	621	558	505	424	385	252	165	
20	559	502	456	380	346	227	148	
22	510	457	415	347	316	206	135	
24	466	420	379	318	290	188	123	
26	432	388	352	294	267	175		
28	400	360	327	273	247	162		
30	375	336	304	254	231	151		

HEAD IN FEET PIPE WILL STAND, SINGLE RIVETED.

Diameter of Pipe in Inches.	No. 8. .165 in.	No. 9. .148 in.	No. 10. .134 in.	No. 11. .120 in.	No. 12. .109 in.	No. 14. .083 in.	No. 16. .065 in.	No. 18. .049 in.
5	1709	1542	1404	1158	1056	739	466	265
6	1439	1297	1180	972	887	619	390	222
7	1242	1120	1018	838	763	533	335	191
8	1093	984	894	737	671	467	294	181
9	977	878	798	657	598	416	262	149
10	882	793	720	593	540	375	236	134
11	806	724	656	540	492	342	215	122
12	738	664	603	495	451	314	196	
13	683	614	557	459	417	290	182	
14	636	571	518	427	388	270	169	
15	594	534	485	398	362	252	158	
16	557	500	454	373	340	236	148	
18	497	446	404	333	302	210	132	
20	448	402	365	299	272	189	118	
22	408	366	332	272	248	172		
24	373	336	303	249	227	157		
26	345	311	282	231	210	146		
28	320	288	261	214	195	135		
30	300	269	243	200	181	126		

HYDRAULIC PIPE.

The thickness of iron is usually proportionate to the head of water and the diameter of the pipe used. Pipes made of different sizes of iron mentioned below, will stand a strain per sectional inch, in pounds avoirdupois, as follows:—

Water Co-efficients.—No 12, strain per inch, 7,000 to 9,000 lbs.; No. 10 to 9, 9.000 to 12,000 lbs.; No. 9 to 3.16, 12,000 to 14,000 lbs.; $\frac{1}{4}$ to $\frac{3}{8}$, 17,000 to 18.000 lbs.

The head of the water in pounds avoirdupois, multiplied by the diameter of the pipe in inches, and divided by the above coefficients, gives twice the thickness necessary of the iron to be used. It is advisable to lower the head of water to avoid leakage, for which due allowance should be made.

Diameter of Rivets to Iron Used.—No. 18 iron, 5-32-inch rivet; 16, 6-32; 14, 5-16; 12, 5-16; 11, 5-16; 10, $\frac{3}{8}$; 8, $\frac{3}{8}$; 7, $\frac{3}{8}$; $\frac{1}{4}$, $\frac{1}{2}$; 5-16, $\frac{5}{8}$; $\frac{3}{8}$, $\frac{3}{4}$ inch.

At Cherokee, Butte Co., Cal., is an inverted siphon of wrought iron; the pipe has an approximate inner diameter of 30 inches, discharging 52 cubic feet of water per second. The iron used in this pipe is ordinary English plate. At its greatest depression this pipe sustains a pressure of 887 feet, and the thickness of the iron at this point is $\frac{3}{8}$ of an inch. The maximum strain on the several sizes of iron used, will be found in the following table.

HYDRAULIC PIPE.—Continued.

Size of Iron.		Pressure.		Strain per Sqr. inch	Size of Iron.		Pressure.		Strain per Sqr. inch
No.	Inch.	Feet.	Pounds.	in pounds.	No.	Inch.	Feet.	Pounds.	in pounds.
14	.083	170	74	13.374	3-16	.187	435	188	15.080
12	.109	288	125	17.202	¼	.250	594	251	15.420
11	.012	293	127	15.878	5-16	.312	842	365	17.594
10	.134	355	154	17.240	⅜	.375	887	384	15.360

The Virginia City & Gold Hill Water Co., Nevada, have a similar siphon, made of wrought iron, 11½ inches in diameter. This pipe sustains a maximum pressure of 750 lbs. per square inch, at the point of its greatest depression, which is 1720 feet, (probably the greatest depression under which water, through pipes, is conducted in the world). This pipe when tested, is said to have stood a pressure of 14,000 lbs. to the square inch.

The accompanying tables will sufficiently illustrate (to those most interested) the manufacture of wrought iron pipe, for the conducting of water under great pressure. The accompanying figures show in detail, the construction of 5,800 feet of wrought iron pipe, 18 inches in diameter, manufactured by the "Risdon Iron Works," of San Francisco, under the superintendence of Mr. Joseph Moore, for the "Spring Valley Water Co.," which company supplies the City of San Francisco with water.

Thickness of Iron used in			Width of Iron			Diameter of Rivets.	Pitch of Circle seams in outside corners.
Pipe.	Bands.	Sleeves.	Sheets.	Bands.	Sleeves.		
Inches.	Inches.	Size.	Inches.	Inches.	Inches.	Inch.	Inches.
¼	5-16	No. 11	42	4½	5½	½	1.4522900
3-16	¼	" 11	42	4½	5½	½	1.4522900
3-16	¼	" 11	44	4½	5½	½	1.4522900
No. 9	¼	" 9	46	4½	5½	⅜	1.1970000
" 11	¼	" 9	40	4½	5½	5-16	.9934692
" 11	¼	" 9	42	4½	5½	5-16	.9934692
" 12	¼	" 9	40	4½	5½	5-16	.9934692
" 12	¼	" 9	38	4½	5½	5-16	.9934692

Pitch of Circle seams in inside corners.	Length of two laps.	Space between double rows.	Length to the joining holes in the	
			Outside Corners.	Inside Corners.
Inches.	Inches.	Inches.	Inches.	Inches.
1.4106233000	2	1.10	56.63931	55.01431
1.4267515000	2	1.10	56.63910	55.40931
1.4267515000	2	1.10	56.63910	55.40931
1.7915000000	1.625	.625	57.45600	56.59900
.9816157517	1.5	.625	57.6212136	56.9337136
.9816157517	1.5	.625	57.6212136	56.9337136
.9837709000	1.25	.625	57.6212136	57.0587136
.9837709000	1.25	.625	57.6212136	57.0587136

Whole length of the corners		Spaces in		Pitch of the small row.	Length of the two.	
Outside.	Inside.	Circle seams	Double row.		Outside spaces small row.	Laps for the double row.
Inches.	Inches	Inch's	Inches	Inches.	Inches.	Inches.
59.73900	58.11400	39	22	17.223	2.1094	2.
59.73931	58.51931	39	22	17.223	2.1094	2,
59.73931	58.51931	39	23	17.223	2.3071	2.
59.70600	58.84920	48	26	1.468	2.2070	1.625
59.74600	59.05730	58	25	1.468	2.0500	1.250
59.74600	59.05730	58	26	1.468	2.3320	1.500
59.49600	58.93330	58	25	1.468	2.0500	1.250
59.49600	58.93330	58	24	1.468	1.5180	1.250

The pipe described in the above table, has as a tensile strain of 5,000 to 6,000 lbs. per sectional inch, and has been made with this low co-efficient in order to withstand the pulsation caused by a single acting plunger pump, working as high as 36 single strokes (four feet in length) per minute. These oscillations are found by testing, to run from 5 to 9 lbs per stroke, when the air vessel is properly charged; through carelessness, however, it may exceed 50 lbs. per stroke.

CAPACITY OF RESERVOIRS IN GALLONS.

NOTE—The columns headed Length and Width denote the length and width in feet; the columns headed Gallons denote the capacity in U. S. gallons of **one foot** in depth.

Length and Width.	Gallons.	Length and Width.	Gallons.	Length and Width.	Gallons.	Length and Width.	Gallons.
1 x 1	7.481	8 x 8	478.753	17 x 11	1398.857	34 x 13	3306.390
2 x 1	14.961	9 x 8	538.597	18 x 11	1481.143	35 x 13	3403.636
3 x 1	22.442	10 x 8	598.442	19 x 11	1563.429	36 x 13	3500.883
2 x 2	29.922	11 x 8	658.286	20 x 11	1645.714	37 x 13	3598.130
3 x 2	44.883	12 x 8	718.130	21 x 11	1728.000	38 x 13	3695.377
4 x 2	59.844	13 x 8	777.974	22 x 11	1810.286	39 x 13	3792.623
5 x 2	74.805	14 x 8	837.818	23 x 11	1892.571	14 x 14	1466.182
6 x 2	89.766	15 x 8	897.662	24 x 11	1974.857	15 x 14	1570.909
3 x 3	67.325	16 x 8	957.507	25 x 11	2057.143	16 x 14	1675.636
4 x 3	89.766	17 x 8	1017.351	26 x 11	2139.428	17 x 14	1780.363
5 x 3	112.208	18 x 8	1077.195	27 x 11	2221.714	18 x 14	1885.091
6 x 3	134.649	19 x 8	1137.039	28 x 11	2304.000	19 x 14	1989.818
7 x 3	157.091	20 x 8	1196.883	29 x 11	2386.286	20 x 14	2094.545
8 x 3	179.532	21 x 8	1256.727	30 x 11	2468.571	21 x 14	2199.273
9 x 3	201.974	22 x 8	1316.571	31 x 11	2550.857	22 x 14	2304.000
4 x 4	119.688	23 x 8	1376.416	32 x 11	2633.143	23 x 14	2408.727
5 x 4	149.610	24 x 8	1436.260	33 x 11	2715.429	24 x 14	2513.454
6 x 4	179.532	9 x 9	605.922	12 x 12	1077.195	25 x 14	2618.182
7 x 4	209.455	10 x 9	673.247	13 x 12	1166.961	26 x 14	2722.909
8 x 4	239.377	11 x 9	740.571	14 x 12	1256.727	27 x 14	2827.636
9 x 4	269.299	12 x 9	807.896	15 x 12	1346.493	28 x 14	2932.364
10 x 4	299.221	13 x 9	875.221	16 x 12	1436.260	29 x 14	3037.091
11 x 4	329.143	14 x 9	942.545	17 x 12	1526.026	30 x 14	3141.818
12 x 4	359.065	15 x 9	1009.870	18 x 12	1615.792	31 x 14	3246.545
5 x 5	187.013	16 x 9	1077.195	19 x 12	1705.558	32 x 14	3351.273
6 x 5	224.416	17 x 9	1144.519	20 x 12	1795.325	33 x 14	3456.000
7 x 5	261.818	18 x 9	1211.844	21 x 12	1885.091	34 x 14	3560.727
8 x 5	299.221	19 x 9	1279.169	22 x 12	1974.857	35 x 14	3665.454
9 x 5	336.623	20 x 9	1346.493	23 x 12	2064.623	36 x 14	3770.182
10 x 5	374.026	21 x 9	1413.818	24 x 12	2154.390	37 x 14	3874.909
11 x 5	411.429	22 x 9	1481.143	25 x 12	2244.156	38 x 14	3979.636
12 x 5	448.831	23 x 9	1548.467	26 x 12	2333.922	39 x 14	4084.364
13 x 5	486.234	24 x 9	1615.792	27 x 12	2423.688	40 x 14	4189.091
14 x 5	523.636	25 x 9	1683.117	28 x 12	2513.455	41 x 14	4293.818
15 x 5	561.039	26 x 9	1750.442	29 x 12	2603.221	42 x 14	4398.545
6 x 6	269.299	27 x 9	1817.766	30 x 12	2692.987	15 x 15	1683.117
7 x 6	314.182	10 x 10	748.052	31 x 12	2782.753	16 x 15	1795.325
8 x 6	359.065	11 x 10	822.857	32 x 12	2872.520	17 x 15	1907.532
9 x 6	403.948	12 x 10	897.662	33 x 12	2962.286	18 x 15	2019.740
10 x 6	448.831	13 x 10	972.467	34 x 12	3052.052	19 x 15	2131.948
11 x 6	493.714	14 x 10	1047.273	35 x 12	3141.818	20 x 15	2244.156
12 x 6	538.597	15 x 10	1122.078	36 x 12	3231.585	21 x 15	2356.364
13 x 6	583.480	16 x 10	1196.883	13 x 13	1264.208	22 x 15	2468.571
14 x 6	628.364	17 x 10	1271.688	14 x 13	1361.454	23 x 15	2580.779
15 x 6	673.247	18 x 10	1346.493	15 x 13	1458.701	24 x 15	2692.987
16 x 6	718.130	19 x 10	1421.299	16 x 13	1555.948	25 x 15	2805.195
17 x 6	763.013	20 x 10	1496.104	17 x 13	1653.195	26 x 15	2917.403
18 x 6	807.896	21 x 10	1570.909	18 x 13	1750.442	27 x 15	3029.610
7 x 7	366.545	22 x 10	1645.714	19 x 13	1847.688	28 x 15	3141.818
8 x 7	418.909	23 x 10	1720.519	20 x 13	1944.935	29 x 15	3254.026
9 x 7	471.273	24 x 10	1795.325	21 x 13	2042.182	30 x 15	3366.234
10 x 7	523.636	25 x 10	1870.130	22 x 13	2139.429	31 x 15	3478.442
11 x 7	576.000	26 x 10	1944.935	23 x 13	2236.675	32 x 15	3590.649
12 x 7	628.364	27 x 10	2019.740	24 x 13	2333.922	33 x 15	3702.857
13 x 7	680.727	28 x 10	2094.545	25 x 13	2431.169	34 x 15	3815.065
14 x 7	733.091	29 x 10	2169.351	26 x 13	2528.416	35 x 15	3927.273
15 x 7	785.455	30 x 10	2244.156	27 x 13	2625.662	36 x 15	4039.480
16 x 7	837.818	11 x 11	905.143	28 x 13	2722.909	37 x 15	4151.688
17 x 7	890.182	12 x 11	987.429	29 x 13	2820.156	38 x 15	4263.896
18 x 7	942.545	13 x 11	1069.714	30 x 13	2917.403	39 x 15	4376.104
19 x 7	994.909	14 x 11	1152.000	31 x 13	3014.649	40 x 15	4488.312
20 x 7	1047.273	15 x 11	1234.286	32 x 13	3111.896	41 x 15	4600.519
21 x 7	1099.636	16 x 11	1316 571	33 x 13	3209.143	42 x 15	4712.727

CAPACITY OF RESERVOIRS IN GALLONS—CONTINUED.

Length and Width.	Gallons.	Length and Width.	Gallons.	Length and Width.	Gallons.	Length and Width.	Gallons.
43 x 15	4824.935	32 x 18	4308.779	34 x 22	5595.429	38 x 30	8527.792
44 x 15	4937.143	33 x 18	4443.429	36 x 22	5924.571	40 x 30	8976.623
45 x 15	5049.351	34 x 18	4578.078	38 x 22	6253.714	42 x 30	9425.454
16 x 16	1915.013	35 x 18	4712.727	40 x 22	6582.857	44 x 30	9874.286
17 x 16	2034.701	36 x 18	4847.377	42 x 22	6912.000	46 x 30	10323.117
18 x 16	2154.390	19 x 19	2700.467	44 x 22	7241.143	48 x 30	10771.948
19 x 16	2274.078	20 x 19	2842.597	24 x 24	4308.779	50 x 30	11220.779
20 x 16	2393.766	21 x 19	2984.727	26 x 24	4667.844	52 x 30	11669.610
21 x 16	2513.454	22 x 19	3126.857	28 x 24	5026.909	54 x 30	12118.442
22 x 16	2633.143	23 x 19	3268.987	30 x 24	5385·974	56 x 30	12567.273
23 x 16	2752.831	24 x 19	3411.117	32 x 24	5745.039	58 x 30	13016.104
24 x 16	2872.519	25 x 19	3553.247	34 x 24	6104.104	60 x 30	13464.935
25 x 16	2992.208	26 x 19	3695.377	36 x 24	6463.169	32 x 32	7660.052
26 x 16	3111.896	27 x 19	3837.506	38 x 24	6822.234	34 x 32	8138.805
27 x 16	3231.584	28 x 19	3979.636	40 x 24	7181.299	36 x 32	8617.558
28 x 16	3351.273	29 x 19	4121.766	42 x 24	7540.364	38 x 32	9096.312
29 x 16	3470.961	30 x 19	4263.896	44 x 24	7899.429	40 x 32	9575.065
30 x 16	3590.649	31 x 19	4406.026	46 x 24	8258.493	42 x 32	10053.818
31 x 16	3710.338	32 x 19	4548.156	48 x 24	8617.558	44 x 32	10532.571
32 x 16	3830.026	33 x 19	4690.286	26 x 26	5056.831	46 x 32	11011.325
17 x 17	2161.870	34 x 19	4832.416	28 x 26	5445.818	48 x 32	11490.078
18 x 17	2289.039	35 x 19	4974.545	30 x 26	5834.805	50 x 32	11968.831
19 x 17	2416.208	36 x 19	5116.675	32 x 26	6223.792	52 x 32	12447.584
20 x 17	2543.377	37 x 19	5258.805	34 x 26	6612.779	54 x 32	12926.338
21 x 17	2670.545	38 x 19	5400.935	36 x 26	7001.766	56 x 32	13405.091
22 x 17	2797.714	20 x 20	2992.208	38 x 26	7390.753	58 x 32	13883.844
23 x 17	2924.883	21 x 20	3141.818	40 x 26	7779.740	60 x 32	14362.597
24 x 17	3052.052	22 x 20	3291.429	42 x 26	8168.727	62 x 32	14841.351
25 x 17	3179.221	23 x 20	3441.039	44 x 26	8557.714	64 x 32	15320.104
26 x 17	3306.390	24 x 20	3590.649	46 x 26	8946.701	34 x 34	8647.480
27 x 17	3433.558	25 x 20	3740.260	48 x 26	9335.688	36 x 34	9156.156
28 x 17	3560.727	26 x 20	3889.870	50 x 26	9724.675	38 x 34	9664.831
29 x 17	3687.896	27 x 20	4039.480	52 x 26	10113.662	40 x 34	10173.506
30 x 17	3815.065	28 x 20	4189.091	28 x 28	5864.727	42 x 34	10682.182
31 x 17	3942.234	29 x 20	4338.701	30 x 28	6283.636	44 x 34	11190.857
32 x 17	4069.403	30 x 20	4488.312	32 x 28	6702.545	46 x 34	11699.532
33 x 17	4196.571	31 x 20	4637.922	34 x 28	7121.454	48 x 34	12208.208
34 x 17	4323.740	32 x 20	4787.532	36 x 28	7540.364	50 x 34	12716.883
18 x 18	2423.688	33 x 20	4937.143	38 x 28	7959.273	52 x 34	13225.558
19 x 18	2558.338	34 x 20	5086.753	40 x 28	8378.182	54 x 34	13734.234
20 x 18	2692.987	35 x 20	5236.364	42 x 28	8797.091	56 x 34	14242.909
21 x 18	2827.636	36 x 20	5385.974	44 x 28	9216.000	58 x 34	14751.584
22 x 18	2962.286	37 x 20	5535.584	46 x 28	9634.909	60 x 34	15260.260
23 x 18	3096.935	38 x 20	5685.195	48 x 28	10053.818	62 x 34	15768.935
24 x 18	3231.584	39 x 20	5834.805	50 x 28	10472.727	64 x 34	16277.610
25 x 18	3366.234	40 x 20	5984.416	52 x 28	10891.636	66 x 34	16786.286
26 x 18	3500.883	22 x 22	3620.571	54 x 28	11310.545	68 x 34	17294.961
27 x 18	3635.532	24 x 22	3949.714	56 x 28	11729.454	36 x 36	9694.753
28 x 18	3770.182	26 x 22	4278.857	30 x 30	6732.467	38 x 36	10233.351
29 x 18	3904.831	28 x 22	4608.000	32 x 30	7181.299	40 x 36	10771.948
30 x 18	4039.480	30 x 22	4937.143	34 x 30	7630.130	42 x 36	11310.545
31 x 18	4174.130	32 x 22	5266.286	36 x 30	8078.961	44 x 36	11849.143

To determine the capacity in gallons of a reservoir find the capacity in cubic inches and divide by 231.

EXAMPLE—Required the capacity in gallons of a reservoir 62 feet in length, 34 feet in width, and 40 feet in depth.

Solution 1.—By computation, with no reference to the table—

$$(62\times12)\times(34\times12)\times(40\times12)\div231 = 630{,}757.4\text{; or,}$$

$$62\times34\times40\times1728\div231 = 630{,}757.4$$

Solution 2.—In the table it is shown that the capacity of a reservoir 62 feet long and 34 feet wide and 1 foot in depth is 15,768.935 gallons.

$$15{,}768.935\times40 = 630{,}757.4 \text{ gallons.}$$

CAPACITY OF CIRCULAR RESERVOIRS IN GALLONS.

NOTE—The columns headed Diameter denote the diameter in feet and inches; the columns headed Gallons denote the capacity in U. S. gallons of **one foot** in depth.

Diameter.	Gallons.	Diameter.	Gallons.	Diameter.	Gallons.	Diameter.	Gallons.
ft. in.		ft. in.		ft. in.		ft. in.	
1	5.8752	14	1151.5392	27	4283.0208	40	9400.32
1 3	9.18	14 3	1193.0328	27 3	4362.7032	40 3	9518.1912
1 6	13.2192	14 6	1235.2608	27 6	4443.12	40 6	9636.7968
1 9	17.9928	14 9	1278.2232	27 9	4524.2712	40 9	9756.1368
2	23.5008	15	1321.92	28	4606.1568	41	9876.2112
2 3	29.7432	15 3	1366.3512	28 3	4688.7768	41 3	9997.02
2 6	36.72	15 6	1411.5168	28 6	4772.1312	41 6	10118.5632
2 9	44.4312	15 9	1457.4168	28 9	4856.22	41 9	10240.8408
3	52.8768	16	1504.0512	29	4941.0432	42	10363.8528
3 3	62.0568	16 3	1551.42	29 3	5026.6008	42 3	10487.5992
3 6	71.9712	16 6	1599.5232	29 6	5112.8928	42 6	10612.08
3 9	82.62	16 9	1648.3608	29 9	5199.9192	42 9	10737.2952
4	94.0032	17	1697.9328	30	5287.68	43	10863.2448
4 3	106.1208	17 3	1748.2392	30 3	5376.1752	43 3	10989.9288
4 6	118.9728	17 6	1799.28	30 6	5465.4048	43 6	11117.3472
4 9	132.5592	17 9	1851.0552	30 9	5555.3688	43 9	11245.5
5	146.88	18	1903.5648	31	5646.0672	44	11374.3872
5 3	161.9352	18 3	1956.8088	31 3	5737.5	44 3	11504.0088
5 6	177.7248	18 6	2010.7872	31 6	5829.6672	44 6	11634.3648
5 9	194.2488	18 9	2065.5	31 9	5922.5688	44 9	11765.4552
6	211.5072	19	2120.9472	32	6016.2048	45	11897.28
6 3	229.5	19 3	2177.1288	32 3	6110.5752	45 3	12029.8392
6 6	248.2272	19 6	2234.0448	32 6	6205.68	45 6	12163.1328
6 9	267.6888	19 9	2291.6952	32 9	6301.5192	45 9	12297.1608
7	287.8848	20	2350.08	33	6398.0928	46	12431.9232
7 3	308 8152	20 3	2409.1992	33 3	6495.4008	46 3	12567.42
7 6	330.48	20 6	2469.0528	33 6	6593.4432	46 6	12703.6512
7 9	352.8792	20 9	2529.6408	33 9	6692.22	46 9	12840.6168
8	376.0128	21	2590.9632	34	6791.7312	47	12978.3168
8 3	399.8808	21 3	2653.02	34 3	6891.9768	47 3	13116.7512
8 6	424.4832	21 6	2715.8112	34 6	6992.9568	47 6	13255.92
8 9	449.82	21 9	2779.3368	34 9	7094.6712	47 9	13395.8232
9	475.8912	22	2843.5968	35	7197.12	48	13536.4608
9 3	502 6968	22 3	2908.5912	35 3	7300.3032	48 3	13677.8328
9 6	530 2368	22 6	2974.32	35 6	7404.2208	48 6	13819.9392
9 9	558.5112	22 9	3040.7832	35 9	7508.8728	48 9	13962.78
10	587.52	23	3107.9808	36	7614.2592	49	14106.3552
10 3	617.2632	23 3	3175.9128	36 3	7720.38	49 3	14250.6648
10 6	647.7408	23 6	3244.5792	36 6	7827.2352	49 6	14395.7088
10 9	678.9528	23 9	3313.98	36 9	7934.8248	49 9	14541.4872
11	710.8992	24	3384.1152	37	8043.1488	50	14688.
11 3	743.58	24 3	3454.9848	37 3	8152.2072	50 3	14835.2472
11 6	776.9952	24 6	3526.5888	37 6	8262.	50 6	14983.2288
11 9	811.1448	24 9	3598.9272	37 9	8372.5272	50 9	15131.9448
12	846.0288	25	3672.	38	8483.7888	51	15281.3952
12 3	881.6472	25 3	3745.8072	38 3	8595.7848	51 3	15431.58
12 6	918.	25 6	3820.3488	38 6	8708.5152	51 6	15582.4992
12 9	955.0872	25 9	3895.6248	38 9	8821.98	51 9	15734 1528
13	992.9088	26	3971.6352	39	8936.1792	52	15886.5408
13 3	1031.4648	26 3	4048.38	39 3	9051.1128	52 3	16039.6632
13 6	1070.7552	26 6	4125.8592	39 6	9166.7808	52 6	16193.52
13 9	1110.78	26 9	4204.0728	39 9	9283.1832	52 9	16348.1112

To determine the capacity in gallons of a circular reservoir multiply the square of the diameter in inches by .7854; multiply the product by the depth in inches; and divide by 231.

EXAMPLE—**Required the capacity in gallons of a circular reservoir 52 feet in diameter and 40 feet in depth.**

Solution 1.—**By computation with no reference to the table—**

$$(52\times12)^2\times.7854\times(40\times12)\div231=635,461.6 \text{ gallons.}$$

Solution 2.—**In the table it is shown that the capacity of a circular reservoir 52 feet in diameter and 1 foot in depth is 15,886.5408 gallons.**

$$15,886.5408\times40=635,461.6 \text{ gallons.}$$

DIMENSIONS OF CIRCULAR CANS, VESSELS, ETC.

The capacity is denoted by the denominations of Wine Measure. The first column indicates the diameter in inches, and the other columns the depth in inches. The figures denoting the depth are expressed in whole numbers and sixteenths.

DIAMETER.	1 Gill	2 Gills	3 Gills	1 Pint.	1¼ Pint.	1½ Pint.	1¾ Pint.	1 Qt.	1¼ Qt.	1½ Qt.	1¾ Qt.	2 Qts.
2	2 5	4 10	6 15	9 4	.....	.....	.....	.....	.....	.....	.....	.....
2¼	1 13	3 10	5 7	7 4	9 1	.....	.....	.....	.....	.....	.....	.....
2½	1 7	2 15	4 6	5 14	7 15	8 13	10 4	.....	.....	.....	.....	.....
2¾	1 3	2 7	3 10	4 14	6 2	7 5	8 9	9 14	12 3	.....	.....	.....
3	1 0	2 1	3 1	4 1	5 2	6 2	7 2	8 3	10 3	12 4	.....	.....
3¼	0 14	1 12	2 10	3 8	4 5	5 3	6 1	6 15	8 11	10 7	12 3	.....
3½	.....	1 8	2 4	3 0	3 12	4 8	5 4	6 0	7 8	9 0	10 8	12 0
3¾	.....	1 5	1 15	2 10	3 4	3 15	4 9	5 4	6 8	7 13	9 2	10 7
4	.....	.....	1 11	2 5	2 14	3 7	4 0	4 9	5 12	6 14	8 0	9 3
4¼	.....	.....	1 8	2 0	2 9	3 1	3 9	4 1	5 1	6 2	7 2	8 2
4½	.....	.....	.....	1 13	2 4	2 11	3 3	3 10	4 8	5 7	6 6	7 4
4¾	.....	.....	.....	.....	2 0	2 7	2 13	3 4	4 1	4 14	5 11	6 8
5	.....	.....	.....	.....	.....	2 3	2 9	2 15	3 11	4 6	5 2	5 14
5¼	.....	.....	.....	.....	.....	.....	2 5	2 11	3 5	4 0	4 11	5 5
5½	.....	.....	.....	.....	.....	.....	2 2	2 7	3 0	3 10	4 4	4 14
5¾	.....	.....	.....	.....	.....	.....	.....	2 3	2 12	3 5	3 14	4 7
6	.....	.....	.....	.....	.....	.....	.....	2 1	2 9	3 1	3 9	4 1
6¼	.....	.....	.....	.....	.....	.....	.....	.....	2 5	2 13	3 5	3 12
6½	.....	.....	.....	.....	.....	.....	.....	.....	2 3	2 10	3 1	3 8
6¾	.....	.....	.....	.....	.....	.....	.....	.....	.....	2 7	2 13	3 3
7	.....	.....	.....	.....	.....	.....	.....	.....	.....	2 4	2 10	3 0
7¼	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2 7	2 13
7½	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2 4	2 10
7¾	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2 7

DIAMETER.	2¼ Qts.	2½ Qts.	2¾ Qts.	3 Qts.	3¼ Qts.	3½ Qts.	3¾ Qts.	1 Gal.	1¼ Gal.	1½ Gal.	1¾ Gal.	2 Gal.
3¾	11 12	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	10 5	11 8	12 10	.....	.....	.....	.....	.....	.....	.....	.....	.....
4¼	9 2	10 3	11 3	12 3	.....	.....	.....	.....	.....	.....	.....	.....
4½	8 3	9 1	10 0	10 14	11 13	12 11	.....	.....	.....	.....	.....	.....
4¾	7 5	8 2	8 15	9 12	10 9	11 6	12 3	13 0	.....	.....	.....	.....
5	6 10	7 5	8 1	8 13	9 9	10 5	11 0	11 12	14 11	.....	.....	.....
5¼	6 0	6 11	7 5	8 0	8 11	9 5	10 0	10 10	13 5	16 0	.....	.....
5½	5 7	6 1	6 11	7 5	7 14	8 8	9 2	9 11	12 2	14 9	17 0	.....
5¾	5 0	5 9	6 2	6 11	7 3	7 12	8 5	8 14	11 2	13 5	15 9	17 12
6	4 9	5 2	5 10	6 2	6 10	7 2	7 10	8 3	10 3	12 4	14 5	16 5
6¼	4 4	4 11	5 3	5 10	6 2	6 9	7 1	7 8	9 6	11 5	13 2	15 1
6½	3 14	4 5	4 12	5 3	5 10	6 1	6 8	6 15	8 11	10 7	12 2	13 15
6¾	3 10	4 0	4 7	4 13	5 4	5 10	6 1	6 7	8 1	9 11	11 5	12 14
7	3 6	3 12	4 2	4 8	4 14	5 4	5 10	6 0	7 8	9 0	10 8	12 0
7¼	3 2	3 8	3 13	4 3	4 9	4 14	5 4	5 9	7 0	8 6	9 13	11 3
7½	2 15	3 4	3 9	3 15	4 4	4 9	4 14	5 3	6 8	7 13	9 2	10 7
7¾	2 12	3 1	3 6	3 11	3 15	4 4	4 9	4 14	6 2	7 5	8 9	9 13
8	.....	2 14	3 2	3 7	3 12	4 0	4 5	4 9	5 12	6 14	8 1	9 3
8¼	.....	.....	2 15	3 4	3 8	3 12	4 1	4 5	5 6	6 8	7 9	8 10
8½	.....	.....	.....	3 1	3 5	3 9	3 13	4 1	5 1	6 2	7 2	8 2
8¾	.....	.....	.....	.....	3 2	3 6	3 9	3 13	4 13	5 12	6 11	7 11
9	.....	.....	.....	.....	.....	3 3	3 6	3 10	4 9	5 7	6 6	7 4
9¼	.....	.....	.....	.....	.....	.....	3 3	3 7	4 5	5 2	6 0	6 14
9½	.....	.....	.....	.....	.....	.....	.....	3 4	4 1	4 11	5 11	6 8
9¾	.....	.....	.....	.....	.....	.....	.....	3 1	3 14	4 10	5 6	6 3
10	.....	.....	.....	.....	.....	.....	.....	.....	3 11	4 6	5 2	5 14
10¼	.....	.....	.....	.....	.....	.....	.....	.....	3 8	4 3	4 14	5 9
10½	.....	.....	.....	.....	.....	.....	.....	.....	3 5	4 0	4 11	5 5
10¾	.....	.....	.....	.....	.....	.....	.....	.....	.....	3 13	4 7	5 1
11	.....	.....	.....	.....	.....	.....	.....	.....	.....	3 10	4 4	4 14
11¼	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4 1	4 10
11½	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3 14	4 7
11¾	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4 4
12	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4 1

DIMENSIONS OF CIRCULAR CANS, VESSELS, ETC.—CONTINUED.

DIAMETER.	2¼ Gal.	2½ Gal.	2¾ Gal.	3 Gal.	3¼ Gal.	3½ Gal.	3¾ Gal.	4 Gal.	4¼ Gal.	4½ Gal.	4¾ Gal.	5 Gal.
6	18 6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6¼	16 15	18 13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6½	15 10	17 6	19 2	.....	.....	.....	.....	.....	.....	.....	.....	.....
6¾	14 8	16 2	17 11	19 4	20 13	.....	.....	.....	.....	.....	.....	.....
7	13 8	15 0	16 8	18 0	19 8	21 0	.....	.....	.....	.....	.....	.....
7¼	12 9	14 0	15 6	16 12	18 3	19 9	20 15	.....	.....	.....	.....	.....
7½	11 12	13 1	14 6	15 11	17 0	18 4	19 9	20 14	22 3	.....	.....	.....
7¾	11 0	12 4	13 7	14 11	15 14	17 2	18 6	19 9	20 13	22 0	23 4	.....
8	10 5	11 8	12 10	13 12	14 15	16 1	17 4	18 6	19 8	20 11	21 13	22 15
8¼	9 11	10 13	11 14	12 15	14 1	15 2	16 3	17 4	18 6	19 7	20 8	21 10
8½	9 2	10 3	11 3	12 3	13 4	14 4	15 4	16 4	17 5	18 5	19 5	20 6
8¾	8 10	9 10	10 9	11 8	12 8	13 7	14 6	15 6	16 5	17 4	18 4	19 3
9	8 3	9 1	10 0	10 14	11 13	12 11	13 10	14 8	15 7	16 5	17 4	18 2
9¼	7 11	8 9	9 7	10 5	11 3	12 0	12 14	13 12	14 10	15 7	16 5	17 3
9½	7 5	8 2	8 15	9 12	10 9	11 6	12 3	13 0	13 13	14 10	15 7	16 5
9¾	6 15	7 12	8 8	9 4	10 1	10 13	11 9	12 6	13 2	13 15	14 11	15 7
10	6 10	7 5	8 1	8 13	9 9	10 5	11 0	11 12	12 8	13 4	13 15	14 11
10¼	6 5	7 0	7 11	8 6	9 1	9 13	10 8	11 3	11 14	12 9	13 5	14 0
10½	6 0	6 11	7 5	8 0	8 11	9 5	10 0	10 11	11 5	12 0	12 11	13 5
10¾	5 11	6 6	7 0	7 10	8 4	8 14	9 9	10 3	10 13	11 7	12 1	12 11
11	5 7	6 1	6 11	7 5	7 14	8 8	9 2	9 11	10 5	10 15	11 9	12 2
11¼	.....	5 13	6 6	6 15	7 9	8 2	8 11	9 5	9 14	10 7	11 0	11 10
11½	.....	5 9	6 2	6 11	7 3	7 12	8 5	8 14	9 7	10 0	10 9	11 2
11¾	.....	.....	5 14	6 6	6 15	7 7	8 0	8 8	9 1	9 9	10 2	10 10
12	.....	.....	.....	6 2	6 10	7 2	7 10	8 3	8 11	9 3	9 11	10 3
12½	.....	.....	.....	.....	6 2	6 9	7 1	7 8	8 0	8 7	8 15	9 6
13	.....	.....	.....	.....	.....	.....	6 8	6 15	7 6	7 13	8 4	8 11
13½	.....	.....	.....	.....	.....	.....	.....	6 7	6 14	7 4	7 10	8 1
14	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7 2	7 8

DIAMETER.	6 Gal.	7 Gal.	8 Gal.	9 Gal.	10 Gal.	11 Gal.	12 Gal.	13 Gal.	14 Gal.	15 Gal.	16 Gal.	17 Gal.
9¼	20 10	24 1	27 8	...	.....	.....	.....	.....	.....	.....	.....	.....
9½	19 9	22 13	26 1	29 5	.....	.....	.....	.....	.....	.....	.....	.....
9¾	18 9	21 10	24 12	27 13	30 15	.....	.....	.....	.....	.....	.....	.....
10	17 10	20 9	23 8	26 7	29 6	.....	.....	.....	.....	.....	.....	.....
10¼	16 13	19 9	22 6	25 3	28 0	30 12	.....	.....	.....	.....	.....	.....
10½	16 0	18 11	21 5	24 0	26 11	29 5	32 1	.....	.....	.....	.....	.....
10¾	15 4	17 13	20 6	22 14	25 7	28 0	30 8	33 1	.....	.....	.....	.....
11	14 9	17 0	19 7	21 14	24 5	26 12	29 2	31 9	34 0	.....	.....	.....
11¼	13 15	16 4	18 9	20 14	23 4	25 9	27 14	30 3	32 8	34 14	.....	.....
11½	13 5	15 9	17 12	20 0	22 4	24 7	26 11	28 14	31 2	33 6	35 9	.....
11¾	12 12	14 14	17 0	19 3	21 5	23 7	25 9	27 11	29 13	31 15	34 1	36 3
12	12 4	14 4	16 5	18 6	20 7	22 7	24 8	26 9	28 9	30 10	32 11	34 11
12½	11 5	13 3	15 1	16 15	18 13	20 11	22 9	24 7	26 5	28 4	30 2	32 0
13	10 7	12 3	13 15	15 10	17 6	19 2	20 14	22 10	24 6	26 2	27 13	29 9
13½	9 11	11 5	12 14	14 8	16 2	17 12	19 6	20 15	22 9	24 3	25 13	27 7
14	9 0	10 8	12 0	13 8	15 0	16 8	18 0	19 8	21 0	22 8	24 0	25 8
15	7 13	9 2	10 7	11 12	13 1	14 6	15 11	17 0	18 5	19 10	20 14	22 3
16	6 14	8 0	9 3	10 5	11 8	12 10	13 12	14 15	16 1	17 3	18 6	19 8
17	6 2	7 2	8 2	9 2	10 3	11 3	12 3	13 4	14 4	15 4	16 4	17 5
18	5 7	6 5	7 4	8 3	9 1	10 00	10 14	11 13	12 11	13 10	14 8	15 7
19	4 14	5 11	6 8	7 5	8 2	8 15	9 12	10 9	11 6	12 3	13 0	13 13
20	4 6	5 2	5 14	6 10	7 5	8 1	8 13	9 9	10 5	11 0	11 12	12 8

DIAMETER.	18 Gal.	19 Gal.	20 Gal.	21 Gal.	22 Gal.	23 Gal.	24 Gal.	25 Gal.	26 Gal.	27 Gal.	28 Gal.	29 Gal.
14	27 0	28 8	30 0	31 8	33 0	34 8	36 0	37 8	39 0	40 8	42 0	43 8
15	23 8	24 13	26 2	27 7	28 12	30 1	31 6	32 11	34 0	35 5	36 9	37 14
16	20 11	21 13	22 15	24 2	25 4	26 7	27 9	28 11	29 14	31 0	32 2	33 5
17	18 5	19 5	20 5	21 6	22 6	23 6	24 7	25 7	26 7	27 7	28 7	29 8
18	16 5	17 4	18 2	19 1	19 15	20 14	21 12	22 11	23 9	24 8	25 6	26 5
19	14 10	15 7	16 5	17 2	17 15	18 12	19 9	20 6	21 3	22 0	22 13	23 10
20	13 4	13 15	14 11	15 7	16 3	16 14	17 10	18 6	19 2	19 13	20 9	21 5

ARTESIAN WELLS.—An artesian well is one in which the waters of a lower stratum are enabled to rise sufficiently near to the surface to permit their economical use. The name artesian is derived from Artois, a province of France, where water has been obtained, from a remote period, by boring vertically down through impermeable strata to a stratum more or less permeable, charged with water in a basin-shaped depression, or so inclined as to reach the surface of the earth at some distance from the point at which the bore-hole is made. Wells of this kind were known to the ancients, and they abounded in the Libyan Desert and the plains of Tyre. To-day they are being successfully used for reclaiming large tracts of Sahara. The principle of the artesian well is very simple. When a hole is bored down through the upper impermeable layer to the surface of an underground reservoir, water is forced up, by the law compelling it to seek its level, to a height greater or less, according to the elevation of level in the feeding column, thus forming a natural fountain on precisely the same principle as that of the common artificial fountain which gets its supply from a height above the jet. It is essential to the success of an artesian well, that there be continuity of permeable stratum between two impermeable strata which have neither flaw nor leakage. The ground to be bored may have a steep inclination extending to the bottom of the water-bearing beds, and then the water supply is necessarily limited. Yet a good supply can be secured if the water-bearing strata be very porous, and have a considerable lateral extension. On the other hand, the inclination of the strata may be very gradual, with a larger area of surface receiving the rainfall. But the condition most favorable to large and constant flow is when most of the rainfall on a surface percolates through to the water-bearing strata. When a boring has to be made to water-bearing strata through other rocks slightly permeable, the quantity of water is more or less seriously affected, and artificial hydrostatic pressure is required. Several kinds of water may be encountered in the same sinking. To suppress an impure flow, water tubes must be inserted in the bore-holes, and this is always necessary when loose sand and strata are struck. When the water has so little hydrostatic pressure that it can not rise to the surface, a pump of some kind must be used, If the level of the water is below thirty feet from the surface, only a plunger-pump is useful. The quantity of water found in any strata does not depend solely on the surface of such strata exposed to the rainfall, but is much influenced by the degree of porosity of the strata, which is the test of their saturative capacity. Water may be obtained by means of short holes a few yards down, when the object is to collect the surface drainage by means of small pumps. Where gravel only is found, water can not generally be procured through short holes; but when the gravel rests on impervious clay, success is assured. If there be a river close to porous strata, it will probably carry off much of the water which would otherwise have saturated the permeable rocks. The geological formations most favorable to artesian borings are those which combine compact and impermeable strata with porous and open rocks. It is hard, even in a known district, to calculate what quantity of water may be expected to drain to a bore-hole, because it is impossible to determine the lateral extension of the drainage. The more porous and saturable the water-bearing strata, the greater the drainage carried to a given point. Artesian tools are not essentially different from those used in sinking mine shafts. Free falling tools, worked by steam power, are employed when bore-holes of large diameter are needed, the weight of the tool giving sufficient percussion to pierce the hardest rock. It is said that a serious difficulty in boring artesian wells has been conquered by an ingenious contrivance invented by the engineer who bored the well on Mare Island, near San Francisco, Cal. He claims to have succeeded in boring an 8-inch hole with a 6-inch drill, and thus making a hole with uniform diameter from top to bottom, instead of the tapering bore which heretofore necessitated serious expense for various casings. The oldest well still flowing is at Lillers, France, dating back to the 12th century. The deepest boring of importance is at Sperenburg, 20 miles from Berlin, sunk for the purpose of getting rock salt. Several years ago it had reached a depth of 4,194 feet, and it is said that the work is still vigorously pushed. A well at Passy, one of the suburbs of Paris, flows steadily at the rate of 5,600,000 gallons a day. But the well of Grenelle, another Parisian suburb, has long been regarded as the most famous and successful of all artesian exploits. Here the chalk was overlaid by gravels, marls, and clays, capable of intercepting the passage of water. It was decided to bore through the chalk into water-bearing sand. This was done; and in 1841, after 8 years' labor, the rods suddenly sank several yards through the subterranean waters. In a few hours the discharge of water was at the rate of 881,884 gallons in 24 hours, with a temperature of 82° F. The surface of the ground at the well is 102 feet above the level of the sea, and the pressure is enough to carry the water 120 feet above this. The exposed surface of the water-bearing beds which supply the well of Grenelle is about 117 square miles; the subterranean area in connection with these lines of outcrop may possibly be about 20,000 square miles; and the average thickness of the sand, etc., or underground reservoir, is not more than 30 feet. The well is 1,798 feet deep, cost $72,500, and has been flowing steadily for about 56 years.

CAPACITY OF BARRELS, CASKS, PIPES AND PUNCHEONS.

NOTE.—The Length and Mean Diameter of a Cask or Package having been found, opposite the former, on the left hand margin, and beneath the latter, on the upper margin, will be found the capacity in **Wine Gallons.**

In computing this table the following rule has been observed:—The square of the mean diameter of the cask, in inches and tenths of inches, is multiplied by the decimal **.0034**, and this product by the length of the cask.

In the final product, any fraction less than **.25** is dropped: if .25, or any intermediate fraction to and including **.75,** it is called one-half gallon; if above .75 to the unit, it is called a whole gallon.

VARIETIES OF CASKS.

Casks are classed in *three* varieties, and the distinction consists in the curvature of the staves, at what is termed the quarter-hoop; that is at a point midway between the bung and chime; viz., Casks having the least curvature are termed the *first* variety; those having a medium curvature the *second* variety; and those having the greatest curvature the *third* variety.

RULE.—To find the **Mean Diameter** of the *first* variety of casks, multiply the difference between the head diameter and the bung diameter (*inside measurement*) by the decimal **.55** and add the product to the head diameter, the sum being the **mean diameter;** for the *second* variety multiply the difference between the two diameters by the decimal **.63**, adding the product to the head diameter; for the *third* variety multiply by the decimal **.70**, and, as above, adding the product to the head.

Having thus found the mean diameter, to find the **Capacity,** multiply the square of the mean diameter, in inches, by the decimal **.0034**, which is substantially the same as dividing by 294, being the number of cylindrical inches in a wine gallon, and the product will be the wine gallons in one inch in length. Multiply this by the length in inches and the product will be the capacity in wine gallons.

Lengths in Inches.	MEAN DIAMETER OF CASKS IN INCHES.												
	10.0	**10.5**	**11.0**	**11.5**	**12.0**	**12.5**	**13.0**	**13.5**	**14.0**	**14.5**	**15.0**	**15.5**	**16.0**
	Gals.	Gals.	Gals.	Gals.	Gals.	Gals	Gals	Gals	Gals.	Gals.	Gals	Gals	Gals.
14.0	5	5	6	6½	....	....	....	....	....	....	....	....	....
14.3	5	5½	6	6½	....	....	....	....	....	....	....	....	....
14.5	5	5½	6	6½	7	....	....	....	....	....	....	....	....
14.7	5	5½	6	6½	7½	8	....	....	....	....	....	....	....
15.0	5	5½	6	6½	7½	8	8½	9½	....	....	....	....	....
15.3	5	5½	6½	7	7½	8½	8½	9½	10	....	....	....	....
15.5	5½	6	6½	7	7½	8½	8½	9½	10½	11	....	....	....
15.7	5½	6	6½	7	7½	8½	8½	9½	10½	11½	12½	....	....
15.9	5½	6	6½	7	8	8½	9	10	10½	11½	12½	13	....
16.0	5½	6	6½	7	8	8½	9	10	11	11½	12½	13½	14
16.3	5½	6	6½	7½	8	8½	9	10	11	12	13	13½	14½
16.5	5½	6	7	7½	8	9	9	10	11	12	13	13½	14½
16.7	5½	6½	7	7½	8	9	9	10½	11	12	13	14	14½
16.9	5½	6½	7	7½	8½	9	10	10½	11½	12	13	14	15
17.0	6	6½	7	7½	8½	9	10	10½	11½	12½	13½	14	15
17.3	6	6½	7	8	8½	9	10	10½	11½	12½	13½	14½	15
17.5	6	6½	7	8	8½	9½	10	11	11½	12½	13½	14½	15½
17.7	6	6½	7½	8	8½	9½	10	11	12	12½	13½	14½	15½
17.9	6	6½	7½	8	9	9½	10½	11	12	13	14	15	15½
18.0	6	6½	7½	8	9	9½	10½	11	12	13	14	15	16
18.3	6	7	7½	8	9	9½	10½	11½	12	13	14	15	16
18.5	6½	7	7½	8½	9	10	10½	11½	12½	13	14	15	16
18.7	6½	7	7½	8½	9	10	10½	11½	12½	13½	14½	15½	16½
18.9	6½	7	8	8½	9½	10	11	11½	12½	13½	14½	15½	16½
19.0	6½	7	8	8½	9½	10	11	12	12½	13½	14½	15½	16½
19.3	6½	7	8	8½	9½	10½	11	12	13	14	15	16	17
19.5	6½	7½	8	9	9½	10½	11	12	13	14	15	16	17
19.7	6½	7½	8	9	9½	10½	11½	12	13	14	15	16	17
19.9	7	7½	8	9	9½	10½	11½	12½	13½	14	15	16½	17½
20.0	7	7½	8	9	10	10½	11½	12½	13½	14½	15½	16½	17½
20.3	7	7½	8½	9	10	11	11½	12½	13½	14½	15½	16½	17½
20.5	7	8	8½	9	10	11	12	12½	13½	14½	15½	16½	18
20.7	7	8	8½	9½	10	11	12	13	14	15	16	17	18
21.0	7½	8	8½	9½	10½	11	12	13	14	15	16	17	18½
21.3	7½	8	8½	9½	10½	11½	12	13	14	15	16½	17½	18½
21.5	7½	8½	9	9½	10½	11½	12½	13½	14½	15½	16½	17½	18½
21.7	7½	8½	9	9½	10½	11½	12½	13½	14½	15½	16½	17½	19
22.0	7½	8½	9	10	11	11½	12½	13½	14½	15½	17	18	19
22.3	8	8½	9	10	11	12	13	14	15	16	17	18	19½
22.5	8	8½	9	10	11	12	13	14	15	16	17	18½	19½
22.7	8	9	9½	10	11	12	13	14	15	16	17½	18½	20
23.0	8	9	9½	10½	11½	12½	13½	14½	15½	16½	17½	19	20
23.3	8	9	9½	10½	11½	12½	13½	14½	15½	16½	18	19	20½

Length in Inches.	MEAN DIAMETER OF CASKS IN INCHES.—*Continued.*												
	16.0	**16.5**	**17.0**	**17.5**	**18.0**	**18.5**	**19.0**	**19.5**	**20.0**	**20.5**	**21.0**	**21.5**	**22.0**
	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.
23.5	20½	22	23	24½	26	27½	29	30½	32	33½	35	36½	38
23.7	20½	22	23½	24½	26	27½	29	30½	32	34	35½	37	38½
23.9	21	22	23½	25	26½	28	29½	31	32½	34	36	37½	39½
24.0	21	22	23½	25	26½	28	29½	31	32½	34½	36	37½	39½
24.3	21	22½	24	25½	27	28½	30	31½	33	34½	36½	38	40
24.5	21½	22½	24	25½	27	28½	30	31½	33½	35	36½	38½	40½
24.7	21½	23	24½	25½	27	28½	30½	32	33½	35½	37	39	40½
24.9	21½	23	24½	26	27½	29	30½	32	34	35½	37½	39	41
25.0	22	23	24½	26	27½	29	30½	32½	34	35½	37½	39½	41
25.3	22	23½	25	26½	28	29½	31	32½	34½	36	38	40	41½
25.5	22	23½	25	26½	28	29½	31½	33	34½	36½	38	40	42
25.7	22½	24	25½	27	28½	30	31½	33	35	36½	38½	40½	42½
25.9	22½	24	25½	27	28½	30	32	33½	35	37	39	40½	42½
26.0	22½	24	25½	27	28½	30½	32	33½	35½	37	39	41	43
26.3	23	24½	26	27½	29	30½	32½	34	36	37½	39½	41½	43½
26.5	23	24½	26	27½	29	31	32½	34½	36	37½	39½	41½	43½
26.7	23	24½	26	28	29½	31	33	34½	36½	38	40	42	44
26.9	23½	25	26½	28	29½	31½	33	35	36½	38½	40½	42½	44½
27.0	23½	25	26½	28	29½	31½	33	35	36½	38½	40½	42½	44½
27.3	24	25½	27	28½	30	32	33½	35½	37	39	41	43	45
27.5	24	25½	27	28½	30½	32	34	35½	37½	39½	41	43	45
27.7	24	25½	27	29	30½	32	34	36	37½	39½	41½	43½	45½
27.9	24½	26	27½	29	30½	32½	34	36	38	40	42	44	46
28.0	24½	26	27½	29	31	32½	34½	36	38	40	42	44	46
28.3	25	26½	28	29½	31	33	34½	36½	38½	40½	42½	44½	46½
28.5	25	26½	28	29½	31½	33	35	37	39	40½	42½	45	47
28.7	25	26½	28	30	31½	33½	35	37	39	41	43	45	47
28.9	25½	27	28½	30	32	33½	35½	37½	39½	41½	43½	45½	47½
29.0	25½	27	28½	30	32	33½	35½	37½	39½	41½	43½	45½	47½
29.3	26	27½	29	30½	32½	34	36	38	40	42	44	46	48
29.5	26	27½	29	30½	32½	34½	36	38	40	42	44	46½	48½
29.7	26	27½	29	31	32½	34½	36½	38½	40½	42½	44½	46½	49
29.9	26½	28	29½	31	33	35	36½	38½	40½	42½	45	47	49
30.0	26½	28	29½	31	33	35	37	39	41	43	45	47	49½
30.3	27	28½	30	31½	33½	35½	37	39	41	43½	45½	47½	50
30.5	27	28½	30	32	33½	35½	37½	39½	41½	43½	45½	48	50
30.7	27	28½	30	32	34	25½	37½	39½	42	44	46	48	50½
	19.0	**19.5**	**20.0**	**20.5**	**21.0**	**21.5**	**22.0**	**22.5**	**23.0**	**23.5**	**24.0**	**24.5**	**25.0**
	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.
30.9	38	40	42	44	46½	48½	51	53	55½	58	60½	63	65½
31.0	38	40	42	44½	46½	48½	51	53½	56	58	60½	63½	66
31.3	38½	40½	42½	44½	47	49	51½	54	56½	59	61½	64	66½
31.5	38½	40½	43	45	47	49½	52	54	56½	59	61½	64½	67
31.7	39	41	43	45½	47½	49½	52	54½	57	59½	62	64½	67½
31.9	39	41	43½	45½	48	50	52½	55	57½	60	62½	65	68
32.0	39½	41½	43½	45½	48	50½	52½	55	57½	60	62½	65½	68
32.3	39½	42	44	46	48½	51	53	55½	58	60½	63½	66	68½
32.5	40	42	44	46½	48½	51	53½	56	58½	61	63½	66½	69
32.7	40	42½	44½	46½	49	51½	54	56½	59	61½	64	66½	69½
32.9	40½	42½	44½	47	49½	51½	54	56½	59	62	64½	67	70
33.0	40½	43	45	47	49½	52	54½	57	59½	62	64½	67½	70
33.3	41	43	45½	47½	50	52½	55	57½	60	62½	65	68	71
33.5	....	43½	45½	48	50	52½	55	57½	60½	63	65½	68½	71
33.7	....	41	46	48	50½	53	55½	58	60½	63½	66	69	71½
33.9	....	44½	46½	48½	51	53½	56	58½	61	63½	66½	69	72
34.0	....	44½	46½	48½	51	53½	56	58½	61	64	66½	69½	72½
34.3	....	45	47	49	51½	54	56½	59	61½	64½	67	70	73
34.5	....	45	47	49	51½	54	57	59½	62	65	67½	70½	73½
34.7	....	....	47½	49½	52	54½	57	59½	62½	65	68	71	73½
34.9	....	....	48	50	52½	55	57½	60	63	65½	68½	71	74
35.0	....	....	48	50	52½	55	57½	60	63	65½	68½	71½	71½
35.3	....	....	48½	50½	53	55½	58	61	63½	66½	69	72	75
35.5	....	....	49	50½	53	56	58½	61	64	66½	69½	72½	75½
35.7	....	....	....	51	53½	56	58½	61½	64	67	70	73	76
35.9	....	....	....	51½	54	56½	59	62	64½	67½	70½	73½	76½
36.0	....	....	....	51½	54½	57	59½	62	64½	67½	70½	73½	76½
36.3	....	....	....	52	55	57	59½	62½	65½	68	71	74	77
36.5	....	....	....	....	55½	57½	60	62½	65½	68½	71½	74½	77½
36.7	....	....	....	....	56	58	60½	63	66	69	72	75	78
36.9	....	....	....	....	56½	58½	61	63½	66½	69½	72½	75½	78½
37.0	....	....	....	....	....	58½	61	63½	66½	70	72½	75½	78½
37.2	....	....	....	....	....	59	61½	64	67	70½	73	76	79½
37.5	....	....	....	....	....	....	62	64½	67½	71	73½	76½	79½
37.7	....	....	....	....	....	....	62½	64½	67½	71	74	77	80
38.0	....	....	....	....	....	....	....	65	68	71½	75	78	80½
38.3	....	....	....	....	....	....	....	....	....	72	75	78½	81½

Length in Inches.	MEAN DIAMETER OF CASKS IN INCHES.—*Continued.*												
	25.0	**25.5**	**26.0**	**26.5**	**27.0**	**27.5**	**28.0**	**28.5**	**29.0**	**29.5**	**30.0**	**30.5**	**31.0**
	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.
28.0	59½	62	64½	67	69½	72½	....	....	....	....	....	....	....
29.0	61½	64	66½	69	72	75	77	....	....	....	....	....	....
30.0	64	66½	69	71½	74½	77	79½	82½	....	....	....	....	....
31.0	66	68½	71½	74	77	79½	82½	85½	89½	....	....	....	....
32.0	68	70½	73½	76½	79½	82½	85½	88½	91½	94½	....	....	....
33.0	70	73	76	79	82	85	88	91	94½	97½	101	....	....
33.5	71	74½	77	80	83	86	89½	92½	96	99	102½	106	....
34.0	72½	75	78	81	84½	87½	90½	94	97	100½	104	107½	111
34.5	73½	76½	79	82	85½	88½	92	95½	98½	102	105½	109	112½
35.0	74½	77½	80½	83½	87	90	93½	96½	100	103½	107	110½	114½
35.5	75½	78½	81½	85	88	91½	94½	98	101½	105	108½	112½	116
36.0	76½	79½	82½	86	89	92½	96	99½	103	106½	110	114	117½
36.5	77½	80½	84	87	90½	94	97½	101	104½	108	111½	115½	119½
37.0	78½	82	85	88½	91½	95	98½	102	106	109½	113	117	121
37.5	79½	83	86	89½	93	96½	100	103½	107	111	114½	118½	122½
38.0	80½	84	87½	90½	94	97½	101½	105	108½	112½	116½	120	124
38.5	82	85	88½	92	95½	99	102½	106½	110	114	118	122	126
39.0	83	86	89½	93	96½	100½	104	107½	111½	115½	119½	123½	127½
39.5	84	87½	91	94½	98	101½	105½	109	113	117	121	125	129
40.0	85	88½	92	95½	99	103	106½	110½	114½	118½	122½	126½	130½
40.5	86	89½	93	96½	100½	104	108	112	116	120	124	128	132½
41.0	87	90½	94	98	101½	105½	109½	113	117	121½	125½	129½	134
41.5	88	92	95½	99	103	106½	110½	114½	118½	123	127	131½	135½
42.0	89½	93	96½	100½	104	108	112	116	120	124½	128½	133	137
42.5	90½	94	97½	101½	105½	109½	113½	117½	121½	126	130	134½	139
43.0	91½	95	99	102½	106½	110½	114½	119	123	127	131½	136	140½
43.5	92½	96	100	104	108	112	116	120	124½	128½	133	137½	142
44.0	93½	97½	101	105	109	113	117½	121½	126	130	134½	139	144
44.5	94½	98½	102½	106½	110½	114½	118½	123	127	131½	136	140½	145½
45.0	95½	99½	103½	107½	111½	115½	120	124½	128½	133	137½	142½	147
45.5	96½	100½	104½	108½	113	117	121½	125½	130	134½	139	144	148½
46.0	97½	101½	105½	110	114	118½	122½	127	131½	136	141	145½	150½
47.0	100	104	108	112	116½	121	125½	130	134½	139	144	148½	153½
48.0	102	106	110½	114½	119	123½	128	132½	137½	142	147	152	157
49.0	104	108½	112½	117	121½	126	130½	135½	140	145	150	155	160
50.0	106½	110½	115	119½	124	128½	133½	138	143	148	153	158	163½
	28.0	**29.0**	**30.0**	**31.0**	**31.5**	**32.0**	**32.5**	**33.0**	**33.5**	**34.0**	**34.5**	**35.0**	**35.5**
	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.
35.0	93½	100	107	114½	118	122	125½	130	134½	....	....	....	....
36.0	96	103	110	117½	121½	125½	129½	133½	137½	143	....	....	....
37.0	98½	106	113	121	125	129	133	137	141	145½	149½	....	....
37.5	100	107	114½	122½	126½	130½	134½	139	143	147½	152	155½	....
38.0	101½	108½	116½	124	128	132½	136½	140½	145	149½	154	158	162
38.5	102½	110	118	126	130	134	138½	142½	147	151½	156	160	164½
39.0	104	111½	119½	127½	131½	136	140	144½	149	153½	158	162½	167
39.5	105½	113	121	129	133½	137½	142	146½	150½	155½	160	164½	169½
40.0	106½	114½	122½	130½	135	139½	143½	148	152½	157	162	166½	171½
40.5	108	116	124	132½	136½	141	145½	150	154½	159	164	168½	173½
41.0	109½	117	125½	134	138½	142½	147	152	156½	161	166	171	175½
41.5	110½	118½	127	135½	140	144½	149	153½	158½	163	168	173	178
42.0	112	120	128½	137	141½	146	151	155½	160½	165	170	175	180
42.5	113½	121½	130	139	143½	148	152½	157½	162	167	172	177	182
43.0	114½	123	131½	140½	145	149½	154½	159	164	169	174	179	184
43.5	116	124½	133	142	147	151½	156	161	166	171	176	181	186½
44.0	117½	126	134½	144	148½	153	158	163	168	173	178	183½	188½
44.5	118½	127	136	145½	150	155	160	165	170	175	180	185½	190½
45.0	120	128½	137½	147	152	156½	161½	166½	171½	177	182	187½	193
45.5	121½	130	139	148½	153½	158½	163½	168½	173½	179	184	189½	195
46.0	122½	131½	141	150½	155	160	165	170½	175½	181	186	191½	197
46.5	124	133	142½	152	157	162	167	172	177½	183	188	193½	199
47.0	125½	134½	144	153½	158½	163½	169	174	179½	184½	190	196	201½
47.5	126½	136	145½	155	160	165½	170½	176	181	186½	192	198	203½
48.0	128	137½	147	157	162	167	172½	177½	183	188½	194	200	205½
48.5	129½	138½	148½	158½	163½	169	174	179½	185	190½	196½	202	208
49.0	130½	140	150	160	165½	170½	176	181½	187	192½	198½	204	210
49.5	132	141½	151½	161½	167	172½	178	183½	189	194½	200½	206	212
50.0	133½	143	153	163½	168½	174	179½	185	191	196½	202½	208½	214
50.5	134½	141½	154½	165	170½	176	1 1½	187	192½	198½	204½	210½	216½
51.0	136	146	156	166½	172	177½	183	189	194½	200½	206½	212½	218½
51.5	137½	147½	157½	168½	173½	179½	185	190½	196½	202½	208½	214½	220½
52.0	138½	148½	159	167	175½	181	186½	192½	198½	204½	210½	216½	223
52.5	140	150	160½	171½	177	183	188½	194½	200½	206½	212½	218½	225
53.0	141½	151½	162	173	179	184½	190½	196	202	208½	214½	220½	227
53.5	142½	153	163½	175	180½	186½	192	198	204	210½	216½	223	229
54.0	144	154½	165	176½	182	188	194	200	206	212	218½	225	231½

Length in Inches	Mean Diameter of Casks in Inches.—*Continued.*													
	32.0	33.0	34.0	35.0	36.0	37.0	38.0	38.5	39.0	39.5	40.0	40.9	49.0	49.9
	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.
54.5	189½	202	214	227	240	253½	267½	274½	....	....	....	....	....	....
55.0	191½	203½	216	229	242½	256	270	277	....	....	....	....	....	....
55.5	193	205½	218	231	244½	258½	272½	279½	....	....	....	....	....	....
56.0	195	207½	220	233	247	260½	275	282	....	....	....	....	....	....
56.5	196½	209	222	235½	249	263	277½	284½	....	....	....	....	....	....
57.0	198½	211	224	237½	251	265½	280	287½	....	....	....	....	....	....
57.5	200	213	226	239½	253½	267½	282½	290	....	....	....	....	....	....
58.0	202	215	228	241½	255½	270	285	292½	....	....	....	....	....	....
58.5	203½	216½	230	243½	258	272½	287	295	....	....	....	....	....	....
59.0	205½	218½	232	245½	260	274½	289½	297½	....	....	....	....	....	....
59.5	207	220½	234	248	262	277	292	300	....	....	....	....	....	....
60.0	209	222	236	250	264½	279½	294½	302½	....	....	....	....	....	....
60.5	210½	224	238	252	266½	282	297	305	....	....	....	....	....	....
61.0	212½	226	240	254	269	284	299½	307½	317	....	....	....	....	....
61.5	214	227½	241½	256	271	286½	302	310	319½	327	....	....	....	....
62.0	216	229½	243½	258	273	288½	304½	312½	322	329½	337	....	....	....
62.5	217½	231½	245½	260½	275½	291	307	315	324½	332	339½	356	....	....
63.0	219½	233½	247½	262½	277½	293	309½	317½	326½	334½	342	359	514½	....
63.5	221	235	249½	264½	280	295½	312	320	329	337	345	361½	518½	537½
64.0	223	237	251½	266½	282	298	314	322½	331	340	347½	364	522½	541½
64.5	224½	239	253½	268½	284	300	316½	325	333½	342½	350½	367	526½	546
65.0	226½	240½	255½	270½	286½	302½	319	327½	336	345	353	370	530½	550
65.5	228	242½	257½	273	288½	305	321½	330	338½	347½	355½	372½	534½	554½
66.0	230	244½	259½	275	291	307	324	332½	341½	350	358½	375½	539	558½
66.5	231½	246	261½	277	293	309½	326½	335	344	353	361	378½	543	563
67.0	233½	248	263½	279	295	312	329	337½	346½	355½	364½	381	547	567
67.5	235	250	265½	281	297½	314	331½	340	349	358	367	384	551	571½
68.0	236½	252	267½	283	299½	316½	334	342½	351½	360½	370	387	555	575½
68.5	238½	253½	269	285½	302	319	336½	345	354	363½	372½	389½	559	580
69.0	240	255½	271	287½	304	321	339	347½	357	366	375½	392½	563½	584
69.5	242	257½	273	289½	306	323½	341	350½	359½	368½	378	395½	567½	588½
70.0	243½	259	275	291½	308½	326	343½	353	362	371½	381	398	571½	592½
70.5	245½	261	277	293½	310½	328	346	355½	364½	374	383½	401	575½	597
71.0	247	262½	279	295½	313	330½	348½	358	367	376½	386	404	579½	601
71.5	249	264½	281	298	315	333	351	360½	370	379½	389	406½	583½	605½
72.0	250½	266	283	300	317	335	353½	363	372½	382	391½	409½	588	609½
72.5	252½	268	285	302	319	337½	356	365½	375	384½	394½	412½	592	614
73.0	254	269½	287	304	321	339½	358	368	377½	387½	397	415	596	618
73.5	256	271½	289	306	323	342	360½	370½	380	390	400	418	600	622½
74.0	....	278	291	308	325	344	363	373	382½	392½	402½	421	604	626½
74.5	....	....	292½	310½	327½	346	365½	375½	385½	395	405½	423½	608	630½
75.0	....	....	....	312½	329½	348½	368	378	388	398	408	426½	612½	635
75.5	....	....	....	....	331½	350½	370½	380½	390½	400½	410½	429½	616½	639
76.0	....	....	....	....	....	352½	372½	383	393	403	413½	432½	620½	643½
76.5	....	....	....	....	....	....	375	385½	395½	406	416	435	624½	647½
76.9	....	....	....	....	....	....	....	388	397½	408	418½	437½	628	651

ULLAGE OR WANTAGE TABLE.

Capacity of Cask.	Bung Diameter.	Number of Dry Inches.													
		2	3	4	5	6	7	8	9	10	11	12	13	14	15
		* Wine Gallons Wanting.													
		Gal	Gal	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals	Gals
22	17	1	2	3	4½	6½	8	10	12	....	....	....	....	....	....
22	18	1	2	3	4	5½	7½	9	11	....	....	....	....	....	....
24	18	1	2	3	4½	6½	8	10	12	....	....	....	....	....	....
24	19	1	2	3	4½	6	7½	9½	11	13	....	....	....	....	....
26	18	1	2	3½	5	7	8½	11	13	....	....	....	....	....	....
26	19	1	2	3	4½	6½	8	10	12	14	....	....	....	....	....
28	18	1	2½	4	5½	7½	9½	11½	14	....	....	....	....	....	....
28	19	1	2	3½	5	7	8½	10½	12½	14½	....	....	....	....	....
42	22	1	2½	4	6	8	10½	12½	15½	18	21	....	....	....	....
43	22	1	2½	4	6½	8½	10½	13½	15½	18½	21½	....	....	....	....
44	22	1½	2½	4	6½	8½	11	13	16	19	22	....	....	....	....
44	23	1	2½	4	6	8	10½	12½	15	17½	20½	....	....	....	....
45	23	1	2½	4	6	8	10½	13	15½	18	20½	23	....	....	....
45	24	1	2½	4	5½	7½	10	12	14½	17	19½	22½	....	....	....
48	23	1	2½	4½	6½	9	11½	13½	16½	19½	22	24½	....	....	....
48	24	1	2½	4	6	8	10½	13	15½	18	21½	24	....	....	....
64	24	1½	3½	5	8	11	14	17	20½	24	28	32	....	....	....
106	30	2	4	6	9½	12½	16½	20½	24½	28½	32½	38	43	47½	53
120	31	2	4	6	9½	13	17	21½	26	31	35	40½	46	51	56½
140	34	2	4	6½	9½	13½	17	22	26	31	36	41	46½	52	58

* Beneath the dry inches, and opposite the capacity and bung diameter of the cask, is stated the ullage or wantage in wine gallons.

DIAMETERS, CICUMFERENCES, AND AREAS OF CIRCLES.

Diam.	Circum.	Areas.	Diam.	Circum.	Areas.	Diam.	Circum.	Areas.
¼	.7854	.049	7⅞	24.7401	48.707	16¼	51.0510	207.394
5-16	.9817	.077	8	25.1328	50.266	16⅜	51.4437	210.597
⅜	1.1781	.110	8⅛	25.5255	51.849	16½	51.8364	213.825
7-16	1,3744	.150	8¼	25.9182	53.456	16⅝	52.2291	217.073
½	1.5708	.196	8⅜	26.3109	55.088	16¾	52.6218	220.353
9-16	1.7671	.248	8½	26.7036	56.745	16⅞	53.0145	223.654
⅝	1.9635	.307	8⅝	27.0963	58.426	17	53.4072	226.981
11-16	2.1598	.371	8¾	27.4890	60.132	17⅛	53.7999	230 330
¾	2.3562	.442	8⅞	27.8817	61.862	17¼	54.1926	233.705
13-16	2.5525	.518	9	28.2744	63.617	17⅜	54.5853	237.104
⅞	2.7489	.601	9⅛	28.6671	65.397	17½	54.9780	240.528
15-16	2.9452	.690	9¼	29.0598	67.201	17⅝	55.3707	243.977
1	3.1416	.785	9⅜	29.4525	69.029	17¾	55.7634	247.450
1⅛	3.5343	.994	9½	29.8452	70.882	17⅞	56.1561	250.947
1¼	3.9270	1.227	9⅝	30.2379	72.760	18	56.5488	254.467
1⅜	4.3197	1.485	9¾	30.6306	74.662	18⅛	56.9415	258.016
1½	4.7124	1.767	9⅞	31.6233	76.589	18¼	57.3342	261.587
1⅝	5.1051	2.074	10	31.4160	78.540	18⅜	57.7269	265.182
1¾	5.4978	2.405	10⅛	31.8087	80.516	18½	58.1196	268.803
1⅞	5.8905	2.761	10¼	32.2014	82.516	18⅝	58.5123	272.447
2	6.2832	3.142	10⅜	32.5941	84.541	18¾	58.9050	276.117
2⅛	6.6759	3.546	10½	32.9868	86.590	18⅞	59.2977	279.811
2¼	7.0686	3.976	10⅝	33.3795	88.664	19	59.6904	283.529
2⅜	7.4613	4.430	10¾	33.7722	90.763	19⅛	60.0831	287.272
2½	7.8540	4.909	10⅞	34.1649	92.886	19¼	60.4758	291.039
2⅝	8.2467	5.412	11	34.5576	95.033	19⅜	60 8685	294.831
2¾	8.6394	5.939	11⅛	34.9503	97.205	19½	61.2612	298.648
2⅞	9.0321	6.492	11¼	35.3430	99.402	19⅝	61.6539	302.489
3	9.4248	7.069	11⅜	35.7357	101.623	19¾	62.0466	306.355
3⅛	9.8175	7.670	11½	36.1284	103 869	19⅞	62.4393	310.245
3¼	10.2102	8.296	11⅝	36.5211	106.139	20	62.8320	314.160
3⅜	10.6029	8.946	11¾	36.9138	108.434	20⅛	63.2247	318.099
3½	10.9956	9.621	11⅞	37.3065	110.754	20¼	63.6174	322.063
3⅝	11.3883	10.321	12	37.6992	113 098	20⅜	64.0101	326.051
3¾	11.7810	11.045	12⅛	38.0919	115.466	20½	64.4028	330 064
3⅞	12.1737	11.793	12¼	38.4846	117.859	20⅝	64.7955	334.101
4	12.5664	12.566	12⅜	38 8773	120.276	20¾	65.1882	338.163
4⅛	12.9591	13.364	12½	39.2700	122.718	20⅞	65.5809	342.250
4¼	13.3518	14.186	12⅝	39.6627	125.184	21	65.9736	346.361
4⅜	13.7445	15.033	12¾	40.0554	127.676	21⅛	66.3663	350.497
4½	14.1372	15.904	12⅞	40.4481	130.192	21¼	66.7590	354.657
4⅝	14.5299	16.800	13	40.8408	132.733	21⅜	67.1517	358.841
4¾	14.9226	17.720	13⅛	41.2335	135.297	21½	67.5444	363.051
4⅞	15.3153	18.665	13¼	41.6262	137,886	21⅝	67.9371	367.284
5	15 7080	19.635	13⅜	42.0189	140.500	21¾	68.3298	371.543
5⅛	16.1007	20.629	13½	42.4116	143.139	21⅞	68.7225	375.826
5¼	16,4934	21.647	13⅝	42.8043	145.802	22	69.1152	380.134
5⅜	16.8861	22.691	13¾	43.1970	148.489	22⅛	69.5079	384·465
5½	17 2788	23.758	13⅞	43.5897	151.201	22¼	69.9066	388.822
5⅝	17.6715	24.850	14	43.9824	153.938	22⅜	70.2933	393.203
5¾	18.0642	25.967	14⅛	44.3751	156,699	22½	70.6860	397.608
5⅞	18.4569	27 108	14¼	44.7678	159.485	22⅝	71.0787	402.038
6	18.8496	28.274	14⅜	45.1605	162.295	22¾	71.4714	406.492
6⅛	19.2423	29.465	14½	45.5532	165.130	22⅞	71.8641	410.972
6¼	19.6350	30.680	14⅝	45.9459	167.989	23	72.2568	415.477
6⅜	20 0277	31.919	14¾	46 3386	170.873	23⅛	72.6495	420.004
6½	20.4204	33.183	14⅞	46.7313	173.782	23¼	73.0422	424.557
6⅝	20.8131	34.472	15	47.1240	176.715	23⅜	73.4349	429.135
6¾	21.2058	35.785	15⅛	47.5167	179.672	23½	73·8276	433.731
6⅞	21.5985	37.122	15¼	47.9094	182.654	23⅝	74.2203	438.363
7	21.9912	38.485	15⅜	48.3021	185.661	23¾	74.6130	443.01[illegible]
7⅛	22.3839	39.871	15½	48.6948	188.692	23⅞	75.0057	447.69[illegible]
7¼	22.7766	41.282	15⅝	49.0875	191·748	24	75.3984	452.390
7⅜	23.1693	42.718	15¾	49.4802	194.828	24⅛	75.7911	457 115
7½	23.5620	44.179	15⅞	49.8729	197.933	24¼	76.1838	461.864
7⅝	23.9547	45.664	16	50.2656	201.062	24⅜	76.5765	466.638
7¾	24.3474	47.173	16⅛	50.6583	204.216	24½	76.9692	471.436

Diameters, Circumferences, and Areas of Circles—Continued.

Diam.	Circum.	Areas.	Diam.	Circum.	Areas.	Diam.	Circum.	Areas.
24⅝	77.3619	476.259	33⅛	104.066	861.792	41⅝	130.769	1360.82
24¾	77.7546	481 106	33¼	104.458	868.309	41¾	131.162	1369.00
24⅞	78.1473	485.978	33⅜	104.851	874.850	41⅞	131.554	1377.21
25	78.5400	490 875	33½	105.244	881.415	**42**	131.947	1385.44
25⅛	78.9327	495.796	33⅝	105.636	888,005	42⅛	132.340	1393.7
25¼	79.3254	500.741	33¾	106.029	894.620	42¼	132.733	1401.9
25⅜	79.7181	505.711	33⅞	106.422	901.259	42⅜	133.125	1410.29
25½	80.1108	510.706	**34**	106.814	907.922	42½	133.518	1418.62
25⅝	80.5035	515.725	34⅛	107.207	914.610	42⅝	133.911	1426.98
25¾	80.8962	520.769	34¼	107.600	921.323	42¾	134.303	1435.36
25⅞	81.2889	525.837	34⅜	107.993	928.060	42⅞	134.696	1443.77
26	81.6816	530.930	34½	108.385	934.822	**43**	135.089	1452.21
26⅛	82.0743	536 047	34⅝	108.778	941.609	43⅛	135.481	1460.65
26¼	82.4670	541.189	34¾	109.171	948.419	43¼	135.874	1469.13
26⅜	82 8597	546.356	34⅞	109.563	955.255	43⅜	136.267	1477.63
26½	83.2524	551.547	**35**	109.956	962.115	43½	136,660	1486.17
26⅝	83.6451	556,762	35⅛	110.349	968.999	43⅝	137.052	1494.72
26¾	84.0378	562.002	35¼	110.741	975.908	43¾	137.445	1503.30
26⅞	84.4305	567.267	35⅜	111.134	982.842	43⅞	137.838	1511.90
27	84.8232	572.557	35½	111.527	989.800	**44**	138.230	1520.53
27⅛	85.2159	577.870	35⅝	111.919	996.783	44⅛	138.623	1529.18
27¼	85.6086	583.208	35¾	112.312	1003.790	44¼	139.016	1537.86
27⅜	86.0013	588.571	35⅞	112.705	1010.822	44⅜	139.408	1546.55
27½	86.3940	593.958	**36**	113.098	1017.878	44½	139.801	1555.28
27⅝	86.7867	599.376	36⅛	113.490	1024.959	44⅝	140.194	1564 03
27¾	87 1794	604.807	36¼	113.883	1032.065	44¾	140.587	1572.81
27⅞	87.5721	610.268	36⅜	114.276	1039.195	44⅞	140.979	1581.61
28	87 9648	615.754	36½	114.668	1046.349	**45**	141.372	1590.43
28⅛	88.3575	621.263	36⅝	115.061	1053.528	45⅛	141.765	1599.28
28¼	88.7502	626.798	36¾	115.454	1060.732	45¼	142.157	1608.15
28⅜	89 1429	632.357	36⅞	115.846	1067.960	45⅜	142.550	1617.04
28½	89.5356	637.941	**37**	116.239	1075.213	45½	142.943	1625.97
28⅝	89.9283	643.549	37⅛	116.632	1082.490	45⅝	143.336	1634.92
28¾	90.3210	649.182	37¼	117.025	1089.792	45¾	143.728	1643.89
28⅞	90.7137	654.839	37⅜	117.417	1097.118	45⅞	144.121	1652.88
29	91.1064	660.521	37½	117.810	1104.469	**46**	144.514	1661·91
29⅛	91.4991	666,227	37⅝	118.203	1111.844	46⅛	144.906	1670.95
29¼	91.8918	671.958	37¾	118.595	1119.244	46¼	145.299	1680.01
29⅜	92 2845	677.714	37⅞	118,988	1126.668	46⅜	145.692	1689.10
29½	92.6772	683.494	**38**	119 381	1134.118	46½	146.084	1698.23
29⅝	93.0699	689.298	38⅛	119.774	1141.591	46⅝	146.477	1707.37
29¾	93.4626	695.128	38¼	120.166	1149.089	46¾	146.870	1716.54
29⅞	93.8553	700.981	38⅜	120.599	1156.612	46⅞	147.263	1725.75
30	94 2480	706.860	38½	120.952	1164.159	**47**	147.655	1734.95
30⅛	94.6407	712.762	38⅝	121.344	1171.731	47⅛	148.048	1744.18
30¼	95.0334	718.690	38¾	121.737	1179.327	47¼	148.441	1753.45
30⅜	95.4261	724.641	38⅞	122 130	1186.948	47⅜	148.833	1762.73
30½	95.8188	730.618	**39**	122.522	1194.593	47½	149.226	1772.05
30⅝	96.2115	736.619	39⅛	122.915	1202.263	47⅝	149.619	1781.39
30¾	96.6042	742.644	39¼	123.308	1209.958	47¾	150.011	1790.76
30⅞	96.9969	748.694	39⅜	123.701	1217.677	47⅞	150.404	1800.13
31	97.3896	754.769	39½	124.093	1225.420	**48**	150.797	1809.54
31⅛	97 7823	760.868	39⅝	124.486	1233.188	48⅛	151.190	1818.99
31¼	98 1750	766.992	39¾	124.879	1240.981	48¼	151.582	1828.46
31⅜	98.5677	773.140	39⅞	125.271	1248.798	48⅜	151.975	1837.93
31½	98.9604	779.313	**40**	125.664	1256.640	48½	152.368	1847.45
31⅝	99.3531	785.510	40⅛	126.057	1264.500	48⅝	152.760	1856.99
31¾	99 7458	791.732	40¼	126.449	1272.390	48¾	153.153	1866.55
31⅞	100.1385	797 978	40⅜	126.842	1280.310	48⅞	153.546	1876.13
32	100.5312	804 250	40½	127.235	1288.250	**49**	153.938	1885.74
32⅛	100.9239	810.545	40⅝	127.627	1296.220	49⅛	154.331	1895.37
32¼	101.3166	816.865	40¾	128.020	1304.210	49¼	154.724	1905.03
32⅜	101.7093	823.209	40⅞	128.413	1312.220	49⅜	155.117	1914.70
32½	102.1020	829.578	**41**	128.806	1320.260	49½	155.509	1924.42
32⅝	102 4947	835.972	41⅛	129.198	1328.321	49⅝	155.902	1934.15
32¾	102.8874	842.390	41¼	129 591	1336.413	49¾	156.295	1943.91
32⅞	103.2801	848.833	41⅜	129 984	1344.522	49⅞	156.687	1953.69
33	103.6730	855.301	41½	130.376	1352.654	**50**	157.080	1963.50

TENSILE STRENGTH OF MATERIALS.

Weight of Power Required to Tear Asunder One Square Inch.

MATERIALS.	Lbs. Avoir
Metals.	
Brass	42,000
" yellow	18,000
Bronze, greatest	56,788
" least	17,698
Copper, bolt	36,800
" cast Am	24,250
" rolled	36,000
" wire	61,200
" wrought	34,000
Copper 10, Tin 1	32,000
" 8, " 1, gun-metal	30,000
Copper 8, Tin 1, bar	50,000
Gold, cast	20,000
Gold 5, Copper 1	50,000
Iron, cast, Low Moor, No. 2	14,076
Iron, cast Am	18,000 30,000
Iron, wro't, best Swedish bar	72,000
Iron, bolts	52,250
" Calder No. 1	13,735
" Clyde No. 1	16,125
" " No. 3	23,468
" crank shaft	44,750
" English bar	56,000
" Greenwood, Am	45,970
" gun-m., mean	37,232
" hammered	53,913
" inferior, bar	30,000
" mean of Am	31,829
" " Eng	53,900
" plates, boiler American	48,000 62,000
Iron plates crosswise	48,800
Iron plates lengthwise	53,800
Iron plates, mean English	51,000
Iron rivets, Am	53,300
" " Eng	65,000
" Russian bar	59,500
" scrap	53,400
" sterling, mean	25,764
" turnings	55,800

MATERIALS.	Lbs. Avoir.
Iron wire, Am	73,000
" " 16 diam	80,000
" wrought wire	103,000
Lead, cast	1,800
" milled	3,320
" wire	2,580
Platinum, Wire	53,000
Silver, cast	40,000
Steel, Am. Tool Co.	179,980
" blistered, soft	104,000 133,000
Steel, cast, maxi'm.	142,000
" " mean	88,657
" crome, mean.	170,980
" plates, crosswise	93,700
Steel, plates, lengthwise	96,300
Steel, puddled, extreme	173,817
Steel razor	150,000
" shear	124,000
" soft	120,000
Tin, Banca	2,122
" cast, block	5,000
Tin 10, Antimony 1	11,000
Yellow metal	48,700
Zinc	3,500
" sheet	16,000
Miscellaneous.	
Brick, fire	65
" inferior	100 290
" well burned	750
Cement, bluestone.	77
" Harwich	30
" hydraulic	234
" Portland, 6 mo	414
" " 1, sand 3	380
" Sheppy	24
Chalk	118
Glass, crown	2,346
Gutta-percha	3,500
Hydraulic lime	140
Hy. lime mortar	140
Ivory	16,000
Leather belts	330
Limestone	670 2,800

MATERIALS	Lbs. Avoir.
Marble, Italian	5,200
" White	9,000
Mortar, 12 yrs old	60
Plaster of Paris	72
Rope, hemp, tarred	15,000
" manila	9.000
" wire	37,000
Sandstone, fine gr.	200
Slate	12,000
Stone, Bath	352
" Craigleth	400
" Hailes	360
" Portland	857 1,000
Whalebone	7,600
Woods.	
Ash	14,000
Bay	14,000
Beech	11,500
Box	20,000
Cedar	11,400
Chestnut, sweet	10,500
Cypress	6,000
Deal, Christiana	12,400
Elm	13,400
Fir, strongest	12,000
Lance	23,000
Lignum vitæ	11,800
Locust	20,500
Mahogany	21,000
" Spanish	8,000 12,000
Maple	10,500
Oak, African	14,500
" Am. white	11,500
" English	10,000
" seasoned	13,600
Pear	9,800
Pine, Am. white	11,800
" larch	9,500
" pitch	12,000
Poplar	7,000
Spruce, white	10,290
Sycamore	13,000
Teak	14,000
Walnut	7,800
Willow	13,000

Tensile Strength is the resistance of the fibres or particles of a body to separation. It is therefore proportional to their number, or to the area of its transverse section. The fibres of wood are strongest near the center of the trunk or limb of a tree.

Cast Iron is extended the 5,500th part of its length for every ton of direct strain per square inch of its section, its elasticity is fully excited when extended less than the 3,000th part of its length, and the limit of its elasticity is reached, when extended the 1,200th part of its length. Tensile strength of the strongest piece of cast iron ever tested was 45,970 pounds, it was a mixture of grades 1, 2, and 3 of Greenwood iron, and at the third fusion.

Wrought Iron is extended the 10,000th part of its length for every ton of direct strain per square inch of its section, its elasticity is fully excited when extended the 1,000th part, and the limit of elasticity estimated at the 1,520th part of its length. The *value* of the above table of metals may be safely taken at from ¼ to ⅓ of the same for the breaking strain. Experiments show that from 1 to 6 re-heatings and rollings, the tensile stress increased from 43,904 pounds to 61,824 pounds and from 6 to 12 re-heatings it was reduced again to 43,904 pounds. For most metals, as the temperature increases the tensile force decreases. Iron bars when cold rolled are materially stronger than when only hot rolled, the difference being as great as 3 to 2.

TREES—TIMBER—LUMBER.

Late in July and early in August, the foliage of sound trees is green, and that of unsound on the turn to autumnal tints. Decayed branches and separation of bark from wood are sure signs of disease. Trees growing in a moist soil produce less durable wood than those which flourish in dry ground. The best timber springs from a dark, gravelly soil. The hardest woods grow in warm climates, and last long, but do not season well. About 45 per cent of wood weight is moisture, and fully 10 per cent remains even after seasoning. The best time to fell timber is in midwinter and midsummer. A tree ought to be mature before it is cut down. Age and rate of growth are shown by the number and width of rings in a cross-section. Oak reaches maturity in about 75 years; ash, larch, and elm in about the same period; and spruce and fir in 80 years. The best timber is nearest the ground. After felling, the bark and whitish sapwood ought to be removed, the tree raised from the ground, and reduced to the form desired. Circular cracks separating the layers are called wind shakes, and injure the tree. Deep splits, checks, and cracks impair the utility of timber trees. Brash is porous wood, of a reddish color, easily broken, and a sign of old age. Belted wood is killed before felling, and is not good timber. Yellow stains show dry rot. Splits which divide the center into segments are called heart shakes; when several radiate from the center, they are called star shakes, and cup shakes when the rings separate. Curved swellings over spots where branches have been removed, are called wind galls. Fibers hurt by crushing are said to be upset. Yellow or red tinge showing decay is called the wood's foxiness. A speckled stain is termed doatiness.

To season timber is to extract the vegetable juices and solidify the albuminous portion. If the wood is subject to a very high temperature, the evaporation proceeds too rapidly, and it will crack. If the sap remains under high temperature, it will ferment and make dry rot. Time required for seasoning depends on density of fibers. The sap may be dissolved by immersion in water. To season well, place timber under dry sheds, and ventilate well. It ought to be repiled occasionally, and defective pieces removed. From two to eight years are required for effective seasoning, and the wood ought to be worked up as soon as it is thoroughly dry. Although the gradual process of natural curing produces strength and durability, artificial processes are successful. The best of these are steaming, and saturating with corrosive sublimate and antiseptic solutions. Strength increases with density and at the roots and centers. Kiln drying will do only for small pieces. Charring, painting, and covering the surface should be practiced only on seasoned wood. Timber can not be seasoned by smoking. Oak loses a fifth of its weight in seasoning, and one-third when dry. Pitch pine requires abnormal time in seasoning. Mahogany is seasoned slowly and pine quickly. Salt water is preferable to fresh in making wood harder, heavier, and more durable. The condition of a tree can be learned by striking it a quick blow. Timber which has been long immersed in water is found to be brashy and useless after exposure to the air. Trees which have been barked in the spring ought not to be felled till the foliage is dead. Common rot is caused by piling in bad sheds, and the signs are yellow spots on ends of pieces and yellowish dust in the cracks. Dry or sap rot is the putrefaction of vegetable albumen, and it can be prevented only by extracting or hardening the albumen, on which fungi subsist. Sugar and gum in the wood attract insects. The best way to preserve timber is to exhaust its fluids, harden its albumen, and inject antiseptics. Impregnation improves the resilience and does not lessen the strength of timber. The jarrow wood of Australia is about the only timber exempt from the ravages of insects. In a very dry atmosphere, the durability of wood is almost unlimited. Even piles driven in fresh water have remained sound longer than 800 years.

Strength of Timbers.—Results of experiments have satisfactorily proved that deflection was sensibly proportional to load; that extension and compression were nearly the same, though the former is greater; that, to produce equal deflection, the load, when placed in the center, was to a load uniformly distributed, as .638 to 1; that deflection under equal loads is inversely as breadths and cubes of the depths, and directly as cubes of the spans. It has also been shown that density of wood varies very little with its age; that the co-efficient of elasticity diminishes after a certain age, and that it depends also on the dryness and exposure of the ground where the wood is grown. Woods from a northerly exposure, on dry ground, have a high co-efficient, while those from swamps, or low, moist ground, have a low one. The tensile strength is influenced by age and exposure. The co-efficient of elasticity of a tree cut down in full vigor, or before it arrives at that stage in its growth, does not present any sensible difference. There is no limit of elasticity in wood, there being a permanent condition for every extension. Fluids will pass with the grain of wood with great facility, but will not enter it except to a very limited extent when applied externally. The weight of a beam of English oak, when wet, was reduced by seasoning from 972.25 to 630.5 pounds.

Table for the Measurement of Logs.

By Act of the Legislature of the State of California, was made the "LEGAL SCALE" for the State. Approved March 28th, 1878. (See Statutes of 1877-78, Chapter CCCCXV.)

SEC. 1. There shall be but one standard for the measurement of logs throughout this state.

SEC. 2. The following table known as "Spaulding's Table for the measurement of logs" is hereby made the standard table for the measurement of logs throughout this State.

EXPLANATION.—The left hand column of figures in the table gives the length in feet of the log; the first line of figures running parallel at the top of each section of the table the diameter; and the other figures indicate the number of feet of square edged boards in each log.

LENGTH IN FEET.	DIAMETER IN INCHES.												
	10	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
12........	38	47	58	71	86	103	121	141	162	184	207	231	256
13........	41	51	62	76	93	111	131	152	175	199	224	250	277
14........	44	55	67	82	100	120	141	164	189	214	241	269	298
15........	47	59	72	88	107	128	151	176	202	230	258	288	320
16........	50	63	77	94	114	137	161	188	216	245	276	308	341
17........	53	67	82	100	121	145	171	199	229	260	293	327	362
18........	57	70	87	106	129	154	181	211	243	276	310	346	384
19........	60	74	91	112	136	163	191	223	256	291	327	365	405
20........	63	78	96	118	143	171	201	235	270	306	345	385	426
21........	66	82	101	124	150	180	211	246	283	322	362	404	448
22........	69	86	106	130	157	188	221	258	297	337	379	423	469
23........	72	90	111	136	164	197	231	270	310	352	396	442	490
24........	76	94	116	142	172	206	242	282	324	368	414	462	512

LENGTH IN FEET.	DIAMETER IN INCHES.												
	23	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**
12........	282	309	337	366	396	427	459	492	526	561	597	634	673
13........	305	334	365	396	429	462	497	533	569	607	646	686	729
14........	329	360	393	427	462	498	535	574	613	654	696	739	785
15........	352	387	421	457	495	533	573	615	657	701	746	792	841
16........	376	412	449	488	528	569	612	656	701	748	796	845	897
17........	399	437	477	518	561	604	650	697	745	794	845	898	953
18........	423	463	505	549	594	640	688	738	789	841	895	951	1009
19........	446	489	533	579	627	676	726	779	832	888	945	1003	1065
20........	470	515	561	610	660	711	765	820	876	935	995	1056	1121
21........	493	540	589	640	693	747	803	861	920	981	1044	1109	1177
22........	517	566	617	671	726	782	841	902	964	1028	1094	1162	1233
23........	540	592	645	701	759	818	879	943	1008	1075	1144	1215	1289
24........	564	618	674	732	792	854	918	984	1052	1122	1194	1268	1346

LENGTH IN FEET.	DIAMETER IN INCHES.												
	36	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
12........	713	755	798	843	889	936	984	1033	1086	1134	1186	1239	1293
13........	772	817	864	913	963	1014	1066	1119	1176	1228	1284	1342	1400
14........	831	880	931	983	1037	1092	1148	1205	1267	1323	1383	1445	1508
15........	891	943	997	1053	1111	1170	1230	1291	1357	1417	1482	1548	1616
16........	950	1006	1064	1124	1185	1248	1312	1377	1448	1512	1581	1652	1724
17........	1010	1069	1130	1194	1259	1326	1394	1463	1538	1606	1680	1755	1831
18........	1069	1132	1197	1264	1333	1404	1476	1549	1629	1701	1779	1858	1939
19........	1128	1195	1263	1334	1407	1482	1558	1635	1719	1795	1877	1961	2047
20........	1188	1258	1330	1405	1481	1560	1640	1721	1810	1890	1976	2065	2155
21........	1247	1321	1397	1475	1555	1638	1722	1807	1900	1984	2075	2168	2262
22........	1307	1384	1463	1545	1629	1716	1804	1893	1991	2079	2174	2271	2370
23........	1366	1447	1529	1615	1703	1794	1886	1979	2081	2173	2273	2374	2478
24........	1426	1510	1596	1686	1778	1872	1968	2066	2172	2268	2372	2478	2586

Table for the Measurement of Logs.—Continued.

Length in Feet.	Diameter in Inches.											
	49	50	51	52	53	54	55	56	57	58	59	60
12	1348	1404	1461	1519	1578	1638	1700	1763	1827	1893	1960	2028
13	1460	1521	1582	1645	1709	1774	1841	1909	1979	2050	2123	2197
14	1572	1638	1704	1772	1841	1911	1983	2056	2131	2208	2286	2366
15	1685	1755	1826	1898	1972	2047	2125	2203	2283	2366	2450	2535
16	1797	1872	1948	2025	2104	2184	2266	2350	2436	2524	2613	2704
17	1909	1989	2069	2151	2235	2320	2408	2497	2588	2681	2776	2873
18	2022	2106	2191	2278	2367	2457	2550	2644	2740	2839	2940	3042
19	2134	2223	2313	2405	2498	2593	2691	2791	2892	2997	3103	3211
20	2246	2340	2435	2531	2630	2730	2833	2938	3045	3155	3266	3380
21	4385	2457	2556	2657	2761	2866	2974	3085	3197	3312	3429	3549
22	2470	2574	2678	2784	2893	3003	3116	3232	3349	3470	3592	3718
23	2582	2691	2800	2911	3024	3139	3258	3379	3501	3628	3756	3887
24	2696	2808	2922	3038	3156	3276	3400	3526	3654	3786	3920	4056

Length in Feet.	Diameter in Inches.											
	61	62	63	64	65	66	67	68	69	70	71	72
12	2098	2169	2241	2315	2390	2467	2545	2625	2706	2789	2874	2960
13	2272	2349	2427	2507	2589	2672	2757	2843	2931	3021	3113	3206
14	2447	2530	2614	2700	2789	2878	2969	3062	3157	3253	3353	3453
15	2622	2711	2801	2893	2987	3083	3181	3281	3382	3486	3592	3700
16	2797	2892	2988	3086	3186	3289	3393	3500	3608	3718	3832	3946
17	2972	3072	3174	3279	3385	3494	3605	3718	3833	3951	4071	4193
18	3147	3253	3361	3472	3585	3700	3817	3937	4059	4183	4311	4440
19	3321	3434	3548	3665	3784	3906	4029	4156	4284	4415	4550	4686
20	3496	3615	3735	3858	3983	4111	4241	4375	4510	4648	4790	4933
21	3671	3795	3921	4051	4182	4316	4453	4593	4735	4880	5029	5180
22	3846	3976	4108	4244	4381	4522	4665	4812	4961	5113	5269	5426
23	4021	4157	4295	4437	4580	4728	4877	5031	5186	5345	5508	5673
24	4196	4338	4482	4630	4780	4934	5090	5250	5412	5578	5748	5920

Length in Feet.	Diameter in Inches.											
	73	74	75	76	77	78	79	80	81	82	83	84
12	3047	3135	3224	3314	3405	3497	3590	3684	3779	3874	3970	4067
13	3301	3396	3492	3590	3688	3788	3889	3991	4094	4196	4301	4406
14	3555	3657	3761	3866	3972	4080	4188	4298	4408	4519	4631	4745
15	3809	3919	4030	4142	4256	4371	4487	4605	4723	4842	4962	5084
16	4062	4180	4298	4418	4519	4663	4786	4912	5038	5165	5293	5423
17	4316	4441	4567	4694	4823	4954	5085	5219	5353	5488	5624	5762
18	4570	4702	4836	4970	5107	5245	5385	5526	5668	5811	5955	6101
19	4824	4964	5104	5246	5391	5537	5684	5833	5983	6133	6285	6440
20	5078	5225	5372	5522	5675	5829	5983	6140	6298	6456	6616	6778

Length in Feet.	Diameter in Inches.											
	85	86	87	88	89	90	91	92	93	94	95	96
12	4165	4264	4364	4465	4566	4668	4771	4875	4980	5085	5192	5300
13	4512	4619	4727	4837	4946	5057	5168	5281	5395	5508	5624	5741
14	4859	4974	5091	5209	5327	5446	5566	5687	5810	5932	6057	6183
15	5206	5330	5455	5581	5707	5835	5964	6094	6225	6356	6490	6625
16	5553	5685	5818	5953	6088	6224	6361	6500	6640	6780	6922	7066
17	5900	6040	6182	6325	6468	6613	6759	6906	7055	7203	7355	7508
18	6247	6396	6546	6697	6849	7002	7156	7312	7470	7627	7788	7950
19	6594	6751	6909	7069	7229	7391	7554	7719	7885	8051	8220	8391
20	6941	7106	7273	7441	7610	7780	7951	8125	8300	8475	8653	8833

Each log to be measured at the top or small end, inside of the bark; and, if not round, to be measured two ways—at right angles—and the difference taken for the diameter. In case of known defects, the deduction should be agreed upon by the buyer and seller, and no fractions of an inch to be taken into the measurement.

LUMBER REDUCED TO BOARD MEASURE.

SIZE IN INS.	LENGTH IN FEET.														
	5	10	12	14	16	18	20	22	24	26	28	30	40	50	60
1x 1	*	†	1	1‡	1⅓	1½	1⅔	1†	2	2‡	2⅓	2½	3⅓	4‡	5
1x 2	†	1⅔	2	2⅓	2⅔	3	3⅓	3⅔	4	4⅓	4⅔	5	6⅔	8⅓	10
1x 3	1¼	2½	3	3½	4	4½	5	5½	6	6½	7	7½	10	12½	15
1x 4	1⅔	3⅓	4	4⅔	5⅓	6	6⅔	7⅓	8	8⅔	9⅓	10	13⅓	16⅔	20
1x 5	2**	4‡	5	5†	6⅔	7½	8⅓	9‡	10	10†	11⅔	12½	16⅔	20†	25
1x 6	2½	5	6	7	8	9	10	11	12	13	14	15	20	25	30
1x 8	3⅓	6⅔	8	9⅓	10⅔	12	13⅓	14⅔	16	17⅓	18⅔	20	26⅔	33⅓	40
1x10	4‡	8⅓	10	11⅔	13⅓	15	16⅔	18⅓	20	21⅔	23⅓	25	33⅓	41⅔	50
1x14	5†	11⅔	14	16⅓	18⅔	21	23⅓	25⅔	28	30⅓	32⅔	35	46⅔	58⅓	70
1x16	6⅔	13⅓	16	18⅔	21⅓	24	26⅔	29⅓	32	34⅔	37⅓	40	53⅓	66⅔	80
1x20	8⅓	16⅔	20	23⅓	26⅔	30	33⅓	36⅔	40	43⅓	26⅔	50	66⅔	83⅓	100
1x28	11⅔	23⅓	28	32⅔	37⅓	42	46⅔	51⅓	56	60⅔	45⅓	70	93⅓	117	140
2x 2	1⅔	3⅓	4	4⅔	5⅓	6	6⅔	7⅓	8	8⅔	9⅓	10	13⅓	16⅔	20
2x 3	2½	5	6	7	8	9	10	11	12	13	14	15	20	25	30
2x 4	3⅓	6⅔	8	9⅓	10⅔	12	13⅓	14⅔	16	17⅓	18⅔	20	26⅔	33⅓	40
2x 6	5	10	12	14	16	18	20	22	24	26	28	30	40	50	60
2x 8	6⅔	13⅓	16	18⅔	21⅓	24	26⅔	29⅓	32	34⅔	37⅓	40	53⅓	66⅔	80
2x10	8⅓	16⅔	20	23⅓	26⅔	30	33⅓	36⅔	40	43⅓	46⅔	50	66⅔	83⅓	100
2x12	10	20	24	28	32	36	40	44	48	52	56	60	80	100	120
2x14	11⅔	23⅓	28	32⅔	37⅓	42	46⅔	51⅓	56	60⅔	65⅓	70	93⅓	117	140
3x 4	5	10	12	14	16	18	20	22	24	26	28	30	40	50	60
3x 6	7½	15	18	21	24	27	30	33	36	39	42	45	60	75	90
3x 8	10	20	24	28	32	36	40	44	48	52	56	60	80	100	120
3x10	12½	25	30	35	40	45	50	55	60	65	70	75	100	125	150
3x12	15	30	36	42	48	54	60	66	72	78	84	90	120	150	180
3x14	17½	35	42	49	56	63	70	77	84	91	98	105	140	175	210
4x 4	6⅔	13⅓	16	18⅔	21⅓	24	26⅔	29⅓	32	34⅔	37⅓	40	53⅓	66⅔	80
4x 6	10	20	24	28	32	36	40	44	48	52	56	60	80	100	120
4x 8	13⅓	26⅔	32	37⅓	42⅔	48	53⅓	58⅔	64	69⅓	74⅔	80	107	133	160
4x10	16⅔	33⅓	40	46⅔	53⅓	60	66⅔	73⅓	80	86⅔	93⅓	100	133	167	200
4x12	20	40	48	56	64	72	80	88	96	104	112	120	160	200	240
4x14	23⅓	46⅔	56	65⅓	74⅔	84	93⅓	103	112	121	131	140	187	234	280
5x 2	4‡	8⅓	10	11⅔	13⅓	15	16⅔	18⅓	20	21⅔	23⅓	25	33⅓	41⅔	50
5x 3	6¼	12½	15	17½	20	22½	25	27½	30	32½	35	37½	50	62½	75
5x 4	8⅓	16⅔	20	23⅓	26⅔	30	33⅓	36⅔	40	43⅓	46⅔	50	66⅔	83⅓	100
5x 5	10*	20†	25	29‡	33⅓	37½	41⅔	45†	50	54‡	58⅓	62½	83⅓	104	125
5x 6	12½	25	30	35	40	45	50	55	60	65	70	75	100	125	150
5x 8	16⅔	33⅓	40	46⅔	53⅓	60	66⅔	73⅓	80	86⅔	93⅓	100	133	167	200
5x10	20†	41⅔	50	58⅓	66⅔	75	83⅓	91⅔	100	108	117	125	167	208	250
5x12	25	50	60	70	80	90	100	110	120	130	140	150	200	250	300
5x14	29‡	58⅓	70	81⅔	93⅓	105	117	128	140	152	163	175	233	292	350
6x 6	15	30	36	42	48	54	60	66	72	78	84	90	120	150	180
6x 8	20	40	48	56	64	72	80	88	96	104	112	120	160	200	240
6x10	25	50	60	70	80	90	100	110	120	125	140	150	200	250	300
6x12	30	60	72	84	96	108	120	132	144	156	168	180	240	300	360
6x14	35	70	84	98	112	126	140	154	168	182	196	210	280	350	420
7x 1	2‖	5†	7	8‡	9⅓	10½	11⅔	12†	14	15‡	16⅓	17½	23⅓	29‡	35
7x 5	14§	29‡	35	40†	46⅔	52½	58⅓	64	70	76	81½	87½	117	146	175
7x 7	20*	40†	49	57‡	65⅓	73½	81⅔	90	98	106	114	123	163	205	245
7x 8	23⅓	46⅔	56	65⅓	74⅔	84	93⅓	103	112	121	131	140	187	234	280
7x 9	26¼	52½	63	73½	84	94½	105	116	126	136	147	157	210	262	315
8x 8	26⅔	53⅓	64	74⅔	85⅓	96	107	117	128	139	149	160	214	267	320
8x10	33⅓	66⅔	80	93⅓	107	120	133	147	160	173	187	200	267	334	400
8x12	40	80	96	112	128	144	160	176	192	208	224	240	320	400	480
8x14	46⅔	93⅓	112	131	149	168	187	205	224	243	261	280	373	468	560
9x 9	33¾	67½	81	94½	108	121	135	148	162	175	189	202	270	337	405
10x10	41‡	83⅓	100	117	133	150	167	183	200	217	233	250	333	417	500
10x12	50	100	120	140	160	180	200	220	240	260	280	300	400	500	600
10x14	58⅓	117	140	163	187	210	133	257	280	303	327	350	467	583	700
11x11	50*	101	121	141	161	181	202	222	242	262	282	302	403	504	605
12x12	60	120	144	168	192	216	240	264	288	312	336	360	480	600	720
12x14	70	140	168	196	224	252	280	308	336	364	392	420	560	700	840
13x13	70*	141	169	197	225	253	282	310	338	366	394	422	563	704	845
14x14	81⅔	163	196	229	261	294	327	359	392	425	457	490	653	817	980
14x16	93⅓	187	224	261	299	336	373	411	448	485	523	560	747	933	1120
16x16	107	213	256	299	341	384	428	470	513	556	598	641	854	1068	1281

* 5-12 of one foot † 5-6. ** 1-12. ‡ 1-6. ‖ 11-12. § 7-12.

Average Weight of the following kinds of Pacific Coast Lumber, Timber, Etc., Green and Dry.

(Weight Decimally Expressed.)

KINDS OF LUMBER.	LUMBER Weight per Foot. Board Measure. Green. Pounds.	Dry. Pounds	LUMBER. Feet in One Ton of 2,000 lbs. Green. Feet.	Dry. Feet.	LUMBER. Feet in One (Broad Gauge) * Carload. Green. Feet.	Dry. Feet.
Fir	r, 4.000	r, 2.50	r, 500.000	r, 800	r, 5,000	r, 8,000
Cedar, Port Orford	r, 3.125	r, 2.50	r, 640.000	r, 800	r, 6,400	r, 8,000
Pine, Mt. Yellow..	r, 3.500	r, 2.50	r, 574.285	r, 800	r, 5,742	r, 8,000
" Oregon......	r, 3.500 d, 2.500	r, 3.00 d, 2.00	r, 574.285 d, 800.000	r, 667 d, 1,000	r, 5,742 d, 8,000	r, 6,667 d, 10,000
" Puget Sound	r, 3.500 d, 2.500	r, 3.00 d, 2.00	r, 574.285 d, 800.000	r, 667 d, 1,000	r, 5,742 d, 8,000	r, 6,667 d, 10,000
" Sugar........	r, 3.000	r, 2.34	r, 666.667	r, 858.37	r, 6,667	r, 8,584
Redwood, Northern	r, 4.000	r, 2.13	r, 500.000	r, 941.18	r, 5,000	r, 9,412
" Southern	r, 4.500	r, 2.50	r, 444.444	r, 800.00	r, 4,444	r, 8,000

* One car-load on C. P. or S. P. R. R. is 20,000 lbs., or 6,000 ft. of lumber, green or dry. (r) stands for *rough*; (d) for dressed. One car-load on S. P. C. R. R. (narrow gauge) is 16,000 lbs. One car-load on S. F. & N. P. R. R., of Redwood is 6,500 ft., green or dry. One car-load on N. P. C. R. R., of Redwood or Fir (green), is 4,000 ft.

NOTE.—Southern Redwood and some specimens of Northern Redwood have been found to weigh as much as 6 lbs. to one foot, board measure, when first sawed.

Comparative Weight of Timber, Green and Seasoned.

[Per Cubic Foot (1,728 Cubic Inches).]

TIMBER.	Green. lbs. ozs.	Seasoned. lbs. ozs.	TIMBER.	Green. lbs. ozs.	Seasoned. lbs. ozs.	TIMBER.	Green. lbs. ozs.	Seasoned lbs. ozs.
Am. Pine	44. 12	30. 11	Beech ..	60. 0	53. 6	Eng. Oak	71. 10	43. 8
Ash......	58. 3	50. 0	Cedar...	32. 0	28. 4	Riga Fir.	48. 12	35. 8

Weight of White Oak, Live Oak, and Yellow Pine.

[Per Cubic Foot (at Different Degrees of Seasoning)]

AGE,	WHITE OAK, VA. Round.	Square.	YELLOW PINE, VA. Round.	Square.	LIVE OAK. Square.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Green	64.7	67.7	39.2	47.8	78.75
One year...........	53.6	58.5	34.2	39.8	——
Two years.	46.	49.9	33.5	34.3	66.75

In England, timber sawed into boards is classed as follows, 6½ to 7 inches in width, *Battens*; 8½ to 10 inches, *Deals*; and 11 to 12 inches, *Planks*.

Distillation.—From a single cord of pitch pine distilled by chemical apparatus, the following substances and in the quantities stated have been obtained:

Charcoal..........	50 bushels	Pyroligneous Acid...........	100 gallons
Illuminating Gas, about..	1,000 cubic feet	Spirits of Turpentine.......	20 "
Illuminating Oil and Tar......	50 gallons	Tar..........................	1 barrel
Pitch or Resin................	1½ barrels.	Wood Spirit......................	5 gallons

EXPANSION OF MATERIALS.

Table of the rates of expansion in bulk, in rising from the freezing point (0° Cent. or 32° Fahr.) to the boiling point (100° Cent. or 212° Fahr.), of the following:

MATERIALS.	Expansion.	MATERIALS.	Expansion.
Air at ordinary pressures.....	0.3660	Iron, Wrought, (and Steel)...	0.0036
Brass.......................	0.0065	Lead	0.0057
Bronze.......................	0.0054	Mercury	0.018153
Brick, Common..............	0.0106	Oil, Linseed and Olive.....	0.08
Brick, Fire	0.0015	Slate	0.0031
Cement......	0.0042	Tin...........................	0.0066
Copper	0.0055	Water, pure	0.04775
Gases, perfect..	0.365	Water, sea, (ordinary)......	0.05
Glass, (average)	0 0027	Wine, Spirit of	0.1112
Iron, Cast	0.0033	Zinc	0.0058

TELEGRAPH POLE, BOAT-OAR, PEDESTAL, or FRUSTUM, PYRAMID AND WEDGE.—How to Calculate the Number of Feet of Lumber (Board Measure), in any Irregular-Shaped Piece of Timber.

The Telegraph pole is usually 8x9 ins. at the base by 4x5 at the top and 24 ft. long. A Boat-oar (in the rough before it is shaped) is 3x3 ins. at the handle by 1½x6 ins. at the blade, and 12 ft. long. Pedestals may be in any proportion; from the shape of a pyramid to a telegraph pole. By the following rule the contents of any one of the above mentioned pieces of timber may be accurately ascertained by any ordinary mathematician:

RULE.—First draw a diagram of the exact shape of the base, or largest end of the piece of timber to be formulated, on a scale representing inches. 2d, within the exact center of the diagram representing the top, or smallest end, on the same relative scale of inches; then make an imaginary line (by dots) from each corner of the inner diagram to the outer edge of the larger diagram, and on a line corresponding to the sides and ends of the inner diagram, which will then represent 9 oblong or square blocks, the center one of which represents a piece of timber of the same size, from end to end of the stick which is easily calculated; by reversing the ends of the side pieces, also the two end pieces, you have two more oblong or square blocks, representing timber the same size from end to end; next, by placing the 4 corner pieces together, 1 piece of timber pyramidal in shape is formed, the rule for calculating which, is to multiply the area of the base by the perpendicular height, and take one-third of the product. (**Note.**—The volume of a pyramid is equal to one-third of that of a prism having equal bases and altitude.) The addition of the sum of all the parts above mentioned will give the answer. Exceptions to the above rule are noted in examples that follow.

Example 1.—How many feet of lumber (board measure) in a telegraph pole 8x9 ins. at the base by 4x5 ins. at the top, and 24 ft. long? Proceed by drafting a diagram as mentioned in the rule above; the center piece will be 4x5 ins. sqr. by 24 ft. long = 40 ft.; the two center end pieces will be 5x2½ ins. at the base by 5x0 at the top; by reversing one of said pieces you have one piece of timber 5x2½ ins. at both ends, 24 ft. long = 25 ft.; the two center side pieces will each be 4x1½ at the base, by 4x0 at the top and 24 ft. long; by reversing one of these pieces you have one piece of timber 4x1½ ins. sqr. and 24 ft. long = 12 ft.; the 4 corner pieces each represent a right-angle triangle at the base; the shorter angle being 1½x2½ ins. for the longer angle, and tapering to a point at the top 24 ft. long; by placing the 4 corner pieces together, 1 piece of timber is formed (pyramidal in shape), 5x3 at the base, running to a point at the apex, and 24 ft. long (see rule above for pyramid,) = 10 ft. 40+25+12+10= Ans., 87 ft. in telegraph pole of the dimensions above stated.

Example 2.—How many feet of lumber, (board measure), in a boat-oar (in the rough) 3x3 at the handle, by 1½x6 ins. at the blade, and 12 ft. long? Solution: A diagram (in this example) of the ends, must cross each other at right angles; it then represents 3 oblong, and 2 square blocks, with an imaginary line drawn connecting the corners, you have 4 more right-angled triangle blocks, making 9 in all, (as in the example of the telegraph pole) the center block represents a piece of timber 3x1½ ins. sqr., 12 ft. long = 4½ ft., the 2 side pieces are 3x¾ ins. (each) at one end, by 3x0 at the other; by reversing 1 of the pieces you have one piece of timber 3x¾ ins. sqr., and 12 ft long = 2¼ ft.; by reversing the 2 end pieces, you have 1 piece 1½x1½ ins. sqr., 12 ft. long = 2¼ ft.; the remaining 4 pieces are double-wedge shape, (the wedges standing at right angles with each other), one end of which is 1½ ins., the other ¾ in., and each piece 12 ft. long; in the center of each piece it will be found to measure ¾x⅜ in. square; calculate each piece as a wedge, from the center of each of the double wedge shaped pieces) 4 of which are ¾x⅜ in. at the base, by 1½x0 at the blade, and 6 ft. long; and the other 4 are ¾x⅜ by ¾x0 and 6 ft. long. (To compute the volume of a wedge:—Rule.—To the length of the edge add twice the length of the back; multiply this sum by the perpendicular height, and then by the breadth of the back, and take one sixth of the product.) By the above rule, the 4 larger wedges contain = ft., and the 4 smaller ones = .28125 ft. (or 40½ sqr. ins.) 4½+2¼+2¼+⅜+.28125= 9 ft. and 94½—144ths, or 9.65625 ft.

Example 3.—How many feet of lumber (board measure) in a piece of timber (pedestal) 22x22 ins. square at the base, and 5x5 at the top, and 32 feet long? Solution: Proceed the same as directed in example 1; your draft will show 5 square and 4 oblong shaped blocks. The center block represents a piece of timber 5x5 ins. square, 32 feet long = 66⅔ feet; the 4 oblong blocks represent (each) a piece of timber 5x8½ at the base by 5x0 at the top; by reversing the ends of 2 of said pieces you have 1 piece of timber (either 10x8½ or) 5x17 ins. square; 32 feet long = 226⅔ feet; the 4 corner pieces represent (each) a piece of timber (at the base) 8½x8½ ins. running to a point at 32 feet; by placing the 4 corner pieces together it forms 1 piece of timber pyramidal in shape, 17x17 ins. at the base, running to a point 32 feet from the center of the base, (see rule above for pyramid), = 256.8888+ feet. 66⅔+226⅔+256·8-9=550.2222+ or 550 ft., and 32-144ths.

To compute the number of feet (board measure) in round timber: Rule—Add the squares of diameters of greater and lesser ends and product of the 2 diameters; multiply same by .7854 and product by ⅓ of length for cubic feet; to reduce to board measure divide cubic feet by 12. Allowance should be made for bark by deducting from each girth, from ½ inch in logs with thin bark, to 2 inches in logs with thick bark. For allowance for sawing into boards, see table for log measurement in another part of this work. It is customary, practically, to take .7 of the diameter for the small end of the log, for the side of the square which can be sawed from a given log.

To find the contents of any irregular body of wood (such as an axe-handle, shoe last, etc.) immerse the body in a vessel full of water and measure the quantity of water displaced.

Weight of Different Metals.

WEIGHT OF ONE SQUARE FOOT.

Thickness.	Weight in Pounds.					
	Cast Iron.	Wrought Iron	Copper.	Lead.	Zinc.	Brass.
1-16 inch.	2.3465	2.5345	2.8880	3.6913	2.3435	2.7484
⅛ "	4.6931	5.0691	5.7760	7.3826	4.6870	5.4968
3-16 "	7.0396	7.6037	8.6640	11.0739	7.0305	8.2453
¼ "	9.3862	10.1383	11.5520	14.7652	9.3740	10.9937
5-16 "	11.7328	12.6729	14.4401	18.4565	11.7175	13.7421
⅜ "	14.0793	15.2075	17.3281	22.1478	14.0610	16.4906
7-16 "	16.4259	17.7421	20.2161	25.8391	16.4045	19.2390
½ "	18.7725	20.2767	23.1041	29.5304	18.7480	21.9875
9-16 "	21.1190	22.8112	25.9921	33.2217	21.0915	24.7359
⅝ "	23.4656	25.3458	28.8802	36.9130	23.4350	27.4843
11-16 "	25.8121	27.8804	31.7682	40.6043	25.7786	30.2328
¾ "	28.1587	30.4150	34.6562	44.2956	28.1221	32.9812
13-16 "	30.5053	32.9496	37.5442	47.9869	30.4656	35.7296
⅞ "	32.8518	35.4842	40.4322	51.6782	32.8091	38.4781
15-16 "	35.1984	38.0188	43.3203	55.3695	35.1526	41.2265
1 "	37.5450	40.5534	46.2083	59.0608	37.4961	43.9750

Metals vary in weight according to quality or manufacture. The weights as given above are sufficiently accurate for ordinary calculations.

ROUND ROLLED IRON—ONE FOOT IN LENGTH.

Inches Diameter.	Pounds in Weight.	Inches Diameter.	Pounds in Weight.	Inches Diameter.	Pounds in Weight.	Inches Diameter.	Pounds in Weight.	Inches Diameter.	Pounds in Weight.
1-16	.010	1⅞	9.331	3⅞	39.855	5⅞	91.612	8¼	180.653
⅛	.041	2	10.617	4	42.468	6	95.552	8½	191.767
3-16	.093	2⅛	11.985	4⅛	45.163	6⅛	99.575	8¾	203.214
¼	.166	2¼	13.437	4¼	47.942	6¼	103.681	9	214.992
⅜	.373	2⅜	14.971	4⅜	50.803	6⅜	107.869	9¼	227.102
½	.664	2½	16.589	4½	53.748	6½	112.141	9½	239.543
⅝	1.037	2⅝	18.289	4⅝	56.775	6⅝	116.495	9¾	252.317
¾	1.493	2¾	20.073	4¾	59.886	6¾	120.933	10	265.422
⅞	2.032	2⅞	21.939	4⅞	63.079	6⅞	125.453	10¼	278.859
1	2.654	3	23.888	5	66.356	7	130.057	10½	292.628
1⅛	3.359	3⅛	25.920	5⅛	69.715	7¼	139.512	10¾	306.728
1¼	4.147	3¼	28.035	5¼	73.157	7⅜	144.365	11	321.161
1⅜	5.018	3⅜	30.233	5⅜	76.682	7½	149.300	11¼	335.925
1½	5.972	3½	32.514	5½	80.290	7⅝	154.318	11½	351.021
1⅝	7.009	3⅝	34.878	5⅝	83.981	7¾	159.419	11¾	366.448
1¾	8.129	3¾	37.325	5¾	87.755	8	169.870	12	382.208

Example—Required the weight of a bar of iron 2⅛ inches in diameter and 12 feet long: 11.985×12 = 143.8 pounds

SQUARE ROLLED IRON—ONE FOOT IN LENGTH.

Inches Square.	Pounds in Weight.	Inches Square.	Pounds in Weight.	Inches Square.	Pounds in Weight.	Inches Square.	Pounds in Weight.	Inches Square.	Pounds in Weight.
1-16	.013	1¾	10.350	3⅝	44.408	5½	102.228	8¾	258.739
⅛	.053	1⅞	11.881	3¾	47.524	5⅝	106.928	9	273.736
3-16	.119	2	13.518	3⅞	50.745	5¾	111.733	9¼	289.154
¼	.211	2⅛	15.260	4	54.071	5⅞	116.644	9½	304.995
⅜	.475	2¼	17.108	4⅛	57.503	6	121.660	9¾	321.259
½	.845	2⅜	19.062	4¼	61.041	6¼	132.010	10	337.945
⅝	1.320	2½	21.122	4⅜	64.685	6½	142.782	10¼	355.054
¾	1.901	2⅝	23.287	4½	68.434	6¾	153.976	10½	372.584
⅞	2.587	2¾	25.557	4⅝	72.289	7	165.593	10¾	390.538
1	3.379	2⅞	27.933	4¾	76.249	7¼	177.632	11	408.914
1⅛	4.277	3	30.415	4⅞	80.315	7½	190.094	11¼	427.712
1¼	5.280	3⅛	33.002	5	84.486	7¾	202.978	11½	446.932
1⅜	6.389	3¼	35.695	5⅛	88.763	8	216.285	11¾	466.575
1½	7.604	3⅜	38.494	5¼	93.146	8¼	230.014	12	486.641
1⅝	8.924	3½	41.398	5⅜	97.634	8½	244.165		

Example—Required the weight of a bar of iron 2⅛ inches square and 12 feet long: 15.26×12=183.1 pounds.

FLAT ROLLED IRON—ONE FOOT IN LENGTH.

Inches.	Pounds in Weight	Inches.	Pounds in Weight	Inches.	Pounds in Weight	Inches.	Pounds in Weight	Inches.	Pounds in Weight
½x⅛	.211	1¼x ¾	3.168	1¾x ⅛	.739	2 x1½	10.138	2⅜x ⅛	1.003
¼	.422	⅞	3.696	¼	1.478	1⅝	10.983	¼	2.007
⅜	.634	1	4.224	⅜	2.218	1¾	11.828	⅜	3.010
⅝x⅛	.264	1⅛	4.752	½	2.957	1⅞	12.673	½	4.013
¼	.528	1⅜x ⅛	.581	⅝	3.696	2⅛x ⅛	.898	⅝	5.016
⅜	.792	¼	1.162	¾	4.435	¼	1.795	¾	6.020
½	1.056	⅜	1.742	⅞	5.175	⅜	2.693	⅞	7.023
¾x⅛	.317	½	2.323	1	5.914	½	3.591	1	8.026
¼	.634	⅝	2.904	1⅛	6.653	⅝	4.488	1⅛	9.029
⅜	.950	¾	3.485	1¼	7.392	¾	5.386	1¼	10.033
½	1.267	⅞	4.066	1⅜	8.132	⅞	6.284	1⅜	11.036
⅝	1.584	1	4.647	1½	8.871	1	7.181	1½	12.039
⅞x⅛	.370	1⅛	5.228	1⅝	9.610	1⅛	8.079	1⅝	13.043
¼	.739	1¼	5.808	1⅞x ⅛	.792	1¼	8.977	1¾	14.046
⅜	1.109	1½x ⅛	.634	¼	1.584	1⅜	9.874	1⅞	15.049
½	1.478	¼	1.267	⅜	2.376	1½	10.772	2	16.052
⅝	1.848	⅜	1.901	½	3.168	1⅝	11.670	2⅛	17.056
¾	2.218	½	2.535	⅝	3.960	1¾	12.567	2¼	18.059
1 x⅛	.422	⅝	3.168	¾	4.752	1⅞	13.465	2½x ⅛	1.056
¼	.845	¾	3.802	⅞	5.544	2	14.362	¼	2.112
⅜	1.267	⅞	4.436	1	6.336	2¼x ⅛	.950	⅜	3.168
½	1.690	1	5.069	1⅛	7.128	¼	1.901	½	4.224
⅝	2.112	1⅛	5.703	1¼	7.921	⅜	2.851	⅝	5.280
¾	2.535	1¼	6.336	1⅜	8.713	½	3.802	¾	6.336
⅞	2.957	1⅜	6.970	1½	9.505	⅝	4.752	⅞	7.393
1⅛x⅛	.475	1⅝x ⅛	.686	1⅝	10.297	¾	5.703	1	8.449
¼	.950	¼	1.373	1¾	11.089	⅞	6.653	1⅛	9.505
⅜	1.426	⅜	2.059	2 x ⅛	.845	1	7.604	1¼	10.561
½	1.901	½	2.746	¼	1.690	1⅛	8.554	1⅜	11.617
⅝	2.376	⅝	3.432	⅜	2.535	1¼	9.505	1½	12.673
¾	2.851	¾	4.119	½	3.379	1⅜	10.455	1⅝	13.729
⅞	3.327	⅞	4.805	⅝	4.224	1½	11.406	1¾	14.785
1	3.802	1	5.492	¾	5.069	1⅝	12.356	1⅞	15.841
1¼x ⅛	.528	1⅛	6.178	⅞	5.914	1¾	13.307	2	16.897
¼	1.056	1¼	6.864	1	6.759	1⅞	14.257	2⅛	17.953
⅜	1.584	1⅜	7.551	1⅛	7.604	2	15.207	2¼	19.009
½	2.112	1½	8.237	1¼	8.449	2⅛	16.158	2⅜	20.065
⅝	2.640	1⅝	8.924	1⅜	9.293	2¼	17.108	2½	21.122

FLAT ROLLED IRON—ONE FOOT IN LENGTH—CONTINUED.

Inches.	Pounds in Weight.	Inches.	Pounds in Weight.	Inches.	Pounds in Weight.	Inches.	Pounds in Weight.	Inches.	Pounds in Weight.
2⅝x ⅛	1.109	3 x ⅛	1.267	3¼x2¼	24.712	3⅝x ½	6.125	3⅞x1⅜	18.006
¼	2.218	¼	2.535	2⅜	26.085	⅝	7.657	1½	19.643
⅜	3.327	⅜	3.802	2½	27.458	¾	9.188	1⅝	21.280
½	4.435	½	5.069	2⅝	28.831	⅞	10.719	1¾	22.917
⅝	5.544	⅝	6.336	2¾	30.204	1	12.250	1⅞	24.554
¾	6.653	¾	7.604	2⅞	31.577	1⅛	13.782	2	26.191
⅞	7.762	⅞	8.871	3	32.950	1¼	15.313	2⅛	27.828
1	8.871	1	10.138	3⅛	34.323	1⅜	16.844	2¼	29.465
1⅛	9.980	1⅛	11.406	3⅜x ⅛	1.426	1½	18.376	2⅜	31.101
1¼	11.089	1¼	12.673	¼	2.851	1⅝	19.907	2½	32.738
1⅜	12.198	1⅜	13.940	⅜	4.277	1¾	21.438	2⅝	34.375
1½	13.307	1½	15.207	½	5.703	1⅞	22.970	2¾	36.012
1⅝	14.415	1⅝	16.475	⅝	7.128	2	24.501	2⅞	37.649
1¾	15.524	1¾	17.742	¾	8.554	2⅛	26.032	3	39.286
1⅞	16.633	1⅞	19.009	⅞	9.980	2¼	27.564	3⅛	40.923
2	17.742	2	20.277	1	11.406	2⅜	29.095	3¼	42.560
2⅛	18.851	2⅛	21.544	1⅛	12.831	2½	30.626	3⅜	44.197
2¼	19.960	2¼	22.811	1¼	14.257	2⅝	32.158	3½	45.834
2⅜	21.069	2⅜	24.079	1⅜	15.683	2¾	33.689	3⅝	47.471
2½	22.178	2½	25.346	1½	17.108	2⅞	35.220	3¾	49.108
2¾x ⅛	1.162	2⅝	26.613	1⅝	18.534	3	36.751	4 x ⅛	1.690
¼	3.323	2¾	27.880	1¾	19.960	3⅛	38.283	¼	3.379
⅜	3.485	2⅞	29.148	1⅞	21.386	3¼	39.814	½	6.759
½	4.647	3⅛x ⅛	1.320	2	22.811	3⅜	41.345	¾	10.138
⅝	5.808	¼	2.640	2⅛	24.237	3½	42.877	1	13.518
¾	6.970	⅜	3.960	2¼	25.663	3¾x ⅛	1.584	1¼	16.897
⅞	8.132	½	5.280	2⅜	27.088	¼	3.168	1½	20.277
1	9.293	⅝	6.600	2½	28.514	⅜	4.752	1¾	23.656
1⅛	10.455	¾	7.921	2⅝	29.940	½	6.336	2	27.036
1¼	11.617	⅞	9.241	2¾	31.365	⅝	7.921	2¼	30.415
1⅜	12.778	1	10.561	2⅞	32.791	¾	9.505	2½	33.794
1½	13.940	1⅛	11.881	3	34.217	⅞	11.089	2¾	37.174
1⅝	15.102	1¼	13.201	3⅛	35.643	1	12.673	3	40.553
1¾	16.264	1⅜	14.521	3¼	37.068	1⅛	14.257	3¼	43 933
1⅞	17.425	1½	15.841	3½x ⅛	1.478	1¼	15.841	3½	47.312
2	18.587	1⅝	17.161	¼	2.957	1⅜	17.425	3¾	50.692
2⅛	19.749	1¾	18.481	⅜	4.435	1½	19.009	4¼x ⅛	1.795
2¼	20.910	1⅞	19.801	½	5.914	1⅝	20.593	¼	3.591
2⅜	22.072	2	21.122	⅝	7.392	1¾	22.178	½	7.181
2½	23.234	2⅛	22.442	¾	8.871	1⅞	23.762	¾	10.772
2⅝	24.395	2¼	23.762	⅞	10.350	2	25.346	1	14.363
2⅞x ⅛	1.214	2⅜	25.082	1	11.828	2⅛	26.930	1¼	17.953
¼	2.429	2½	26.402	1⅛	11.307	2¼	28.514	1½	21.544
⅜	3.643	2⅝	27.722	1¼	14.785	2⅜	30.098	1¾	25.135
½	4.858	2¾	29.042	1⅜	16.264	2½	31.682	2	28.725
⅝	6.072	2⅞	30.362	1½	17.742	2⅝	33.266	2¼	32.316
¾	7.287	3	31.682	1⅝	19.221	2¾	34.851	2½	35.907
⅞	8.501	3¼x ⅛	1.373	1¾	20.699	2⅞	36.435	2¾	39.497
1	9.716	¼	2.746	1⅞	21.178	3	38.019	3	43.088
1⅛	10.930	⅜	4.119	2	23.656	3⅛	39.603	3¼	46.679
1¼	12.145	½	5.492	2⅛	25 135	3¼	41.187	3½	50.269
1⅜	13.359	⅝	6.864	2¼	26.613	3⅜	42.771	3¾	53.860
1½	14.574	¾	8.237	2⅜	28.092	3½	44.355	4	57.451
1⅝	15.788	⅞	9.610	2½	29.570	3⅝	5.939	4½x ¼	3.802
1¾	17.003	1	10.983	2⅝	31.049	3⅞x ⅛	1.637	½	7.604
1⅞	18.217	1⅛	12.356	2¾	32.527	¼	3.274	¾	11.406
2	19.432	1¼	13.729	2⅞	34.006	⅜	4.911	1	15.207
2⅛	20.646	1⅜	15.102	3	35.484	½	6.548	1¼	19.009
2¼	21.861	1½	16.475	3⅛	36.963	⅝	8.185	1½	22.811
2⅜	23.075	1⅝	17.848	3¼	38.441	¾	9.821	1¾	26.613
2½	24.290	1¾	19.221	3⅜	39.920	⅞	11.453	2	30.415
2⅝	25.504	1⅞	20.593	3⅝x ⅛	1.531	1	13.095	2¼	34.217
2¾	26.719	2	21.966	¼	3.063	1⅛	14.732	2½	38.019
2⅞	27.933	2⅛	23.339	⅜	4.594	1¼	16.369	2¾	41.821

FLAT ROLLED IRON—ONE FOOT IN LENGTH—CONTINUED.

Inches.	Pounds in Weight.	Inches.	Pounds in Weight.	Inches.	Pounds in Weight.	Inches.	Pounds in Weight.	Inches.	Pounds in Weight.
4½x3	45.623	5 x ¾	12.673	5¼x2½	44.355	5½x4	74.348	5¾x5¼	102.017
3¼	49.424	1	16.897	2¾	48.791	4¼	78.995	5½	106.875
3½	53.226	1¼	21.122	3	53.226	4½	83.641	6 x ¼	5.069
3¾	57.028	1½	25.346	3¼	57.662	4¾	88.288	½	10.138
4	60.830	1¾	29.570	3½	62.097	5	92.935	¾	15.207
4¼	64.632	2	33.794	3¾	66.533	5¼	97.582	1	20.277
4¾x ¼	4.013	2¼	38.019	4	70.968	5¾x ¼	4.858	1¼	25.346
½	8.026	2½	42.243	4¼	75.404	½	9.716	1½	30.415
¾	12.039	2¾	46.467	4½	79.839	¾	14.754	1¾	35.484
1	16.052	3	50.692	4¾	84.275	1	19.432	2	40.553
1¼	20.065	3¼	54.916	5	88.711	1¼	24.290	2¼	45.623
1½	24.079	3½	59.140	5½x ¼	4.647	1½	29.148	2½	50.692
1¾	28.092	3¾	63.365	½	9.293	1¾	34.006	2¾	55.761
2	32.105	4	67.589	¾	13.940	2	38.864	3	60.830
2¼	36.118	4¼	71.813	1	18.587	2¼	43.722	3¼	65.899
2½	40.131	4½	76.038	1¼	23.234	2½	48.580	3½	70.968
2¾	44.144	4¾	80.262	1½	27.880	2¾	53.438	3¾	77.038
3	48.157	5¼x ¼	4.435	1¾	32.527	3	58.295	4	81.107
3¼	52.170	½	8.871	2	37.174	3¼	63.153	4¼	86.176
3½	56.183	¾	13.307	2¼	41.821	3½	68.011	4½	91.245
3¾	60.196	1	17.742	2½	46.467	3¾	72.869	4¾	96.314
4	64.210	1¼	22.178	2¾	51.114	4	77.727	5	101.383
4¼	68.223	1½	26.613	3	55.761	4¼	82.585	5¼	106.452
4½	72.236	1¾	31.049	3¼	60.408	4½	87.443	5½	111.522
5 x ¼	4.224	2	35.484	3½	65.054	4¾	92.301	5¾	116.591
½	8.449	2¼	39.920	3¾	69.701	5	97.159	6	121.660

Example—Required the weight of a bar of iron 4½ inches wide, 3 inches thick, and 12 feet long:

45.623×12=547.5 pounds.

Weight and Volume of Cast Iron and Lead Balls.

From 1 *to* 20 *inches Diameter.*

Diam. Inches	Volume cubic ins.	Cast Iron pounds.	Lead, pounds.	Diam. Inches	Volume cubic ins.	Cast Iron pounds.	Lead pounds.
1.	.5235	.1365	.2147	8.½	321.5550	83.8396	131.883
1.½	1.7671	.4607	.7248	9.	381.7034	99.5103	156.553
2.	4.1887	1.0920	1.7180	9.½	448.9204	117.0338	184.121
2.½	8.1812	2.1328	3.3554	10.	523.5987	136.5025	214.749
3.	14.1371	3.6855	5.7982	11.	696.9098	181.7648	285.832
3.½	22.4492	5.8525	9.2073	12.	904.7784	235.8763	371.096
4.	33.5103	8.7361	13.7440	13.	1150.346	299.6230	471.806
4.½	47.7129	12.4387	19.5690	14.	1436.754	374.5629	589.273
5.	65.4498	17.0628	26.843	15.	1767.145	460.6959	724.781
5.½	87.1137	22.7206	35.729	16.	2144.660	559.1142	879.616
6.	113.0973	29.4845	46.385	17.	2572.440	670.7168	1055.066
6.½	143.7932	37.4528	58.976	18.	3053.627	796.0825	1252.422
7.	179.5943	46.8203	73.659	19.	3591.363	936.2708	1472.970
7.½	220.8932	57.5870	90.598	20.	4188.790	1092.02	1717.995
8.	268.0825	69.8892	109.952	......	....	....	....

To compute dressed weight of cattle, measure as follows in feet: Girth close behind shoulders, that is, over crop and under plate, immediately behind elbow. Length from point between neck and body, or vertically above junction of cervical and dorsal processes of spine, along back to bone at tail, and in a vertical line with rump. Then multiply square of girth, in feet, by length, and multiply product by factors in the following table, and quotient will give dressed weight of quarters :—

CONDITION.	Heifer, Steer or Bullock.	Bull.	CONDITION.	Heifer, Steer or Bullock.	Bull.
Half fat.............	3.15	3.36	Very prime fat.......	3.64	3.85
Moderate fat.........	3.36	3.5	Extra fat............	3.78	4.06
Prime fat	3.5	3.64			

Weights of Wrought Iron, Steel, Copper and Brass Plates.

Thickness Determined by Birmingham Gauge.

No. of Gauge.	Thickness in inches.	WEIGHT OF PLATES PER SQUARE FOOT IN LBS. Wrought Iron	Steel.	Copper.	Brass.	No. of Gauge.
0000	.454	18.2167	18.4596	20.5662	19.4312	0000
000	.425	17.0531	17.2805	19.2525	18.19	000
00	.38	15.2475	15.4508	17.214	16.264	00
0	.34	13.6425	13.8244	15.402	14.552	0
1	.3	12.0375	12.198	13.59	12.84	1
2	.284	11.3955	11.5474	12.8652	12.1552	2
3	.259	10.3924	10.5309	11.7327	11.0852	3
4	.238	9.5497	9.6771	10.7814	10.1864	4
5	.22	8.8275	8.9452	9.966	9.416	5
6	.203	8.1454	8.254	9.1959	8.6884	6
7	.18	7.2225	7.3188	8.154	7.704	7
8	.165	6.6206	6.7089	7.4745	7.062	8
9	.148	5.9385	6.0177	6.7044	6.3344	9
10	.134	5.3767	5.4484	6.0702	5.7352	10
11	.12	4.815	4.8792	5.436	5.136	11
12	.109	4.3736	4.4319	4.9377	4.6652	12
13	.095	3.8119	3.8627	4.3035	4.066	13
14	.083	3.3304	3.3748	3.7599	3.5524	14
15	.072	2.889	2.9275	3.2616	3.0816	15
16	.065	2.6081	2.6429	2.9445	2.782	16
17	.058	2.3272	2.3583	2.6274	2.4824	17
18	.049	1.9661	1.9923	2.2197	2.0972	18
19	.042	1.6852	1.7077	1.9026	1.7976	19
20	.035	1.4044	1.4231	1.5855	1.498	20
21	.032	1.284	1.3011	1.4496	1.3696	21
22	.028	1.1235	1.1385	1.2684	1.1984	22
23	.025	1.0031	1.0165	1.1325	1.07	23
24	.022	.8827	.8945	.9966	.9416	24
25	.02	.8025	.8132	.906	.856	25
26	.018	.7222	.7319	.8154	.7704	26
27	.016	.642	.6506	.7248	.6848	27
28	.014	.5617	.5692	.6342	.5992	28
29	.013	.5216	.5286	.5889	.5564	29
30	.012	.4815	.4879	.5436	.5136	30
31	.01	.4012	.4066	.453	.428	31
32	.009	.3611	.3659	.4077	.3852	32
33	.008	.321	.3253	.3624	.3424	33
34	.007	.2809	.2846	.3171	.2996	34
35	.005	.2006	.2033	.2265	.214	35
36	.004	.1605	.1626	.1812	.1712	36

Weights of Wrought Iron, Steel, Copper and Brass Plates.

Soft Rolled. *Thickness determined by American Gauge.*

No. of gauge	Thickness in inches.	WEIGHT OF PLATES PER SQUARE FOOT IN POUNDS, Wrought Iron	Steel.	Copper.	Brass.	No of gauge
0000	.46	18.4575	18.7036	20.838	19.688	0000
000	.40964	16.4368	16.6559	18.5567	17.5326	000
00	.3648	14.6376	14.8328	16.5254	15.6131	00
0	.32486	13.0351	13.2088	14.7162	13.904	0
1	.2893	11.6082	11.7629	13.1053	12.382	1
2	.25763	10.3374	10.4752	11.6706	11.0266	2
3	.22942	9.2055	9.3283	10.3927	9.8192	3
4	.20431	8.1979	8.3073	9.2552	8.7445	4
5	.18194	7.3004	7.3977	8.2419	7.787	5
6	.16202	6.5011	6.5878	7.3395	6.9345	6
7	.14428	5.7892	5.8664	6.5359	6.1752	7
8	.12849	5.1557	5.2244	5.8206	5.4994	8
9	.11443	4.5915	4.6527	5.1837	4.8976	9
10	.10189	4.0884	4.1428	4.6156	4.3609	10
11	.090742	3.641	3.6896	4.1106	3.8838	11
12	.080808	3.2424	3.2856	3.6606	3.4586	12
13	.071961	2.8874	2.9259	3.2598	3.0799	13
14	.064084	2.5714	2.6057	2.903	2.7428	14
15	.057068	2.2899	2.3204	2.5852	2.4425	15
16	.050820	2.0392	2.0664	2.3021	2.1751	16

Weights of Wrought Iron, Steel, Etc. (Soft Rolled)—Continued.

Thickness Determined by American Gauge.

No. of gauge	Thickness in inches.	Weight of Plates per Square Foot in Pounds.				No. of gauge
		Wrought Iron	Steel.	Copper.	Brass.	
17	.045257	1.8159	1.8402	2.0501	1.937	17
18	.040303	1·6172	1.6387	1.8257	1.725	18
19	.035890	1.44	1.4593	1.6258	1.5361	19
20	.031961	1.2824	1.2995	1.4478	1.3679	20
21	.028462	1.142	1.1573	1.2893	1.2182	21
22	.025347	1.017	1.0306	1.1482	1.0849	22
23	.022571	.9057	.9177	1.0225	.96604	23
24	.0201	.8065	.8173	.91053	.86028	24
25	.0179	.7182	.7278	.81087	.76612	25
26	.01594	.6396	.6481	.72208	.68223	26
27	.014195	.5696	.5772	.64303	.60755	27
28	.012641	.5072	.514	.57264	.54103	28
29	.011257	.4517	.4577	.50994	.4818	29
30	.010025	.4023	.4076	.45413	.42907	30
31	.008928	.3582	.363	.40444	.38212	31
32	.00795	.319	.3232	.36014	.34026	32
33	.00708	.2841	.2879	.32072	.30302	33
34	.006304	.2529	.2563	.28557	.26981	34
35	.005614	.2253	.2283	.25431	.24028	35
36	.005	.2006	.2033	.2265	.214	36
37	.004453	.1787	.181	.20172	.19059	37
38	.003965	.1591	.1612	.17961	.1697	38
39	.003531	.1417	.1436	.15995	.15113	39
40	.003144	.1261	.1278	.14242	.13456	40

Size, Weight, Length and Strength of "Iron Wire."

Wire Gauge No.	Diam. inches.	Weight of.			Length in feet of.		Br'king strain pounds.	Wire Gauge No.
		one foot pounds.	100 feet pounds.	one mile pounds.	1bdl 63lb. feet.	100 lbs. feet.		
00	0.380	.38266	38.266	2,020.44	164.637	261.328	8,290	00
0	0.340	.30634	30.634	1,617.48	205.653	326.433	6,880	0
1	0.300	.23850	23.850	1,259.28	264.151	419.287	5,650	1
2	0.284	.21374	21.374	1,128.54	294.753	467.861	4,930	2
3	0.259	.17777	17.777	938.60	354.400	562.539	4,250	3
4	0.238	.15011	15.011	792.56	419.700	666.190	3,620	4
5	0.220	.12826	12.826	677.21	491.189	779.665	3,040	5
6	0.203	.10920	10.920	576.60	576.902	915.717	2,510	6
7	0.180	.08586	8.586	452.34	733.752	1,164.685	2,220	7
8	0.165	.07215	7.215	380.93	873.229	1,386.077	1,840	8
9	0.148	.05805	5.805	306.48	1,085.346	1,722.771	1,560	9
10	0.134	.04758	4.758	251.24	1,324.002	2,101.590	1,280	10
11	0.120	.03816	3.816	201.48	1,650.943	2,628.481	1,000	11
12	0.109	.03149	3.149	166.24	2,000.952	3,176.114	800	12
13	0.095	.02392	2.392	126.28	2,634.215	4,181.294	568	13
14	0.083	.01826	1.826	96.39	3,456.343	5,486.259	456	14
15	0.072	.01374	1.374	72.54	4,585.819	7,279.077	452	15
16	0.065	.01120	1.120	59.11	5,627.009	8,931.760	264	16
17	0.058	.00892	.892	47.07	7,066.741	11,217.049	208	17
18	0.049	.00636	.636	33.60	9,900.990	15,715.857	160	18
19	0.042	.00468	.468	24.68	13,475.914	21,390.340	128	19
20	0.035	.00325	.325	17.14	19,408.502	30,807.146	104	20
21	0.032	.00271	.271	14.33	23,212.969	36,845.982	80	21
22	0.028	.00208	.208	10.97	30,317.613	48,123.195	56	22

Weight of Lead and Zinc Plates.

Per superficial foot, from 1-16 to 1 inch in thickness.

Thick. inches.	Lead, lbs.	Zinc, lbs.	Thick. inches.	Lead, lbs.	Zinc, lbs.	Thick. inches.	Lead, lbs.	Zinc, lbs.	Thick. inches.	Lead, lbs.	Zinc, lbs.
.0625	3.7	2.3	.3125	18.5	11.7	.5625	33.2	21.1	.8125	48.0	30.4
.125	7.4	4.7	.375	22.2	14.0	.625	36.9	23.4	.875	51.7	32.8
.1875	11.1	7.0	.4375	25.9	16.4	.6875	40.6	25.7	.9375	55.4	35.1
.25	14.8	9.4	.5	29.5	18.7	.75	44.3	28.1	1.0000	59.1	37.5

Wrought Iron, Steel, Copper, and Brass wire.

Diameter and Thickness Determined by Birmingham Gauge.

No. of Gauge.	Diam. of each No. In.	Weight of Wire per Lineal Foot Expressed in Decimals of a Pound.				No. of Gauge.
		Wrought Iron.	Steel.	Copper.	Brass.	
0000	.454	.546207	.551360	.623913	.589286	0000
000	.425	.478656	.483172	.546752	.516407	000
00	.38	.38266	.38627	.437099	.41284	00
0	.34	.30634	.30923	.349921	.3305	0
1	.3	.2385	.24075	.27243	.25731	1
2	.284	.213738	.215755	.244146	.230596	2
3	.259	.177765	.179442	.203054	.191785	3
4	.238	.150107	.151523	.171461	.161945	4
5	.22	.12826	.12947	.146507	.138376	5
6	.203	.109204	.110234	.12474	.117817	6
7	.18	.08586	.086667	.098075	.092632	7
8	.165	.072146	.072827	.08241	.077836	8
9	.148	.058046	.058593	.066303	.062624	9
10	.134	.047583	.048032	.054353	.051336	10
11	.12	.03816	.03852	.043589	.04117	11
12	.109	.031485	.031782	.035964	.033968	12
13	.095	.023916	.024142	.027319	.025802	13
14	.083	.018256	.018428	.020853	.019696	14
15	.072	.013738	.013867	.015692	.014821	15
16	.065	.011196	.011302	.012789	.012079	16
17	.058	.008915	.008999	.010183	.009618	17
18	.049	.006363	.006423	.007268	.006864	18
19	.042	.004675	.004719	.00534	.005043	19
20	.035	.003246	.003277	.003708	.003502	20
21	.032	.002714	.002739	.0031	.002928	21
22	.028	.002078	.002097	.002373	.002241	22
23	.025	.001656	.001672	.001892	.001787	23
24	.022	.001283	.001295	.001465	.001384	24
25	.02	.00106	.001070	.001211	.001144	25
26	.018	.0008586	.0008667	.0009807	.0009263	26
27	.016	.0006784	.0006848	.0007749	.0007319	27
28	.014	.0005194	.0005243	.0005933	.0005604	28
29	.013	.0004479	.0004521	.0005116	.0004832	29
30	.012	.0003816	.0003852	.0004359	.0004117	30
31	.01	.000265	.0002675	.0003027	.0002859	31
32	.009	.0002147	.0002167	.0002452	.0002316	32
33	.008	.0001696	.0001712	.0001937	.000183	33
34	.007	.0001299	.0001311	.0001483	.0001401	34
35	.005	.00006625	.00006688	.00007568	.00007148	35
36	.004	.0000424	.0000428	.00004843	.00004574	36

Wrought Iron, Steel, Copper and Brass Wire.

Diameter and Thickness Determined by American Gauge.

No. of Gauge.	Diam. of each No. In.	Weight of Wire per Lineal Foot Expressed in Decimals of a Pound.				No. of Gauge.
		Wrought Iron.	Steel.	Copper.	Brass.	
0000	.46	.56074	.566030	.640513	.605176	0000
000	.40964	.444683	.448879	.507946	.479908	000
00	.3648	.352659	.355986	.40283	.380666	00
0	.32486	.279665	.282303	.319451	.301816	0
1	.2893	.221789	.223891	.253342	.239353	1
2	·25763	.175888	.177548	.200911	.189818	2
3	.22942	.139480	.140796	·159323	.150522	3
4	.20431	.110616	.111660	.126353	.119376	4
5	.18194	.087720	088548	.1002	·094666	5
6	.16202	.069565	.070221	.079462	.075075	6
7	.14428	.055165	.055685	.063013	.059545	7
8	.12849	.043751	.044164	.049976	.047219	8
9	.11443	.034699	.035026	.039636	.037437	9
10	.10189	.027512	.027772	.031426	.029687	10
11	.090742	.021820	.022026	.024924	.023549	11
12	.080808	.017304	.017468	.019766	.018676	12
13	.071961	.013722	.013851	.015674	.014809	13
14	.064084	.010886	.010989	.012435	.011746	14
15	.057068	.008631	.008712	.009859	.009315	15

Wrought Iron, Steel, Copper and Brass Wire.—Continued.

Diameter and Thickness Determined by American Gauge.

No. of Gauge.	Diam. of each No. In.	Weight of Wire per Lineal Foot Expressed in Decimals of a Pound.				No. of Gauge.
		Wrought Iron.	Steel.	Copper.	Brass.	
16	.050820	.006845	.006909	.007819	.007587	16
17	.045257	.005427	.005478	.006199	.005857	17
18	.040303	.004304	.004344	.004916	.004645	18
19	.035890	.003413	.003445	.003899	.003684	19
20	.031961	.002708	.002734	.003094	.002920	20
21	.028462	.002147	.002167	.002452	.002317	21
22	.025347	.001703	.001719	.001945	.001838	22
23	.022571	.001350	.001363	.001542	.001457	23
24	.0201	.001071	.001081	.001223	.001155	24
25	.0179	.0008491	.0008571	.0009699	.0009163	25
26	.01594	.0006734	.0006797	.0007692	.0007267	26
27	.014195	.000534	.0005391	.0006099	.0005763	27
28	.012641	.0004235	.0004275	.0004837	.000457	28
29	.011257	.0003358	.0003389	.0003835	.0003624	29
30	.010025	.0002663	.0002688	.0003042	.0002874	30
31	.008928	.0002113	.0002132	.0002413	.000228	31
32	.00795	.0001675	.0001691	.0001913	.0001808	32
33	.00708	.0001328	.0001341	.0001517	.0001434	33
34	.006304	.0001053	.0001063	.0001204	.0001137	34
35	.005614	.00008366	.00008445	.0000956	.00009015	35
36	.005	.00006625	.00006687	.0000757	.0000715	36
37	.004453	.00005255	.00005304	.00006003	.00005671	37
38	.003965	.00004166	.00004205	.00004758	.00004496	38
39	.003531	.00003305	.00003336	.00003775	.00003566	39
40	.003144	.00002620	.00002644	.00002992	.00002827	46

Wire and Hemp Rope.

Tabular scale, showing approximately the comparative strength, sizes, and weight per 100 feet in length, of Wire and Hemp Rope.

The sizes on each horizontal line being of equal strength.

Capacity of Ropes.		Round Iron Wire Rope.		Round Steel Wire Rope.		Round Hemp Rope.		Flat Iron Wire Rope.	
Working Load. Lbs.	Breaking Strength. Tons.	Circumference. Inches.	Weight 100 feet. Lbs.	Circumference. Inches	Weight 100 feet. Lbs.	Circumference. Inches.	Weight 100 feet. Lbs.	Size. Inches.	Weight 100 feet. Lbs.
300	1	1	17	—	—	2¾	33	—	—
550	1½	1¼	23	—	—	3	50	—	—
800	2½	1½	33	1	17	3¼	55	—	—
1,500	4½	1¾	52	1½	33	4¼	78	—	—
2,000	6	2	65	1⅝	36	5	100	—	—
2,500	7½	2¼	86	1¾	52	6	160	—	—
3,300	10	2½	108	2	65	6½	166	—	—
4,200	12½	2¾	124	2⅛	75	7	200	2x⅜	144
5,000	15	3	140	2¼	86	7½	234	2¼x⅜	154
6,000	18	3¼	158	2⅜	97	7¾	250	2½x⅜	171
7,000	21	3½	180	2½	110	8¼	284	3x⅜	220
8,000	24	3¾	200	3	140	9	333	3x½	270
9,000	27	4	250	3¼	158	10	433	4x⅜	275
10,000	30	4¼	284	3½	190	10½	466	4x½	388
11,000	33	4½	320	3⅝	195	11	500	4½x½	397
12,000	36	4¾	350	3¾	200	12	567	5x½	400
13,500	40	5	380	3⅞	225	13	784	5½x½	450
18,000	55	5½	440	4	250	14	900	6x½	500
22,000	65	6	540	4¼	280	16	1166	6½x½	560

Thickness of "Sheet" Brass, Gold, Silver, etc.

By Birmingham Gauge for these Metals.

No.	Inch.	No.	Inch.	No.	Inch.	No.	Inch.	No.	Inch.	No.	Inch.
1	.004	7	.015	13	.036	19	.064	25	.095	31	.133
2	.005	8	.016	14	.041	20	.067	26	.103	32	.140
3	.008	9	.019	15	.047	21	.072	27	.112	33	.147
4	.010	10	.024	16	.051	22	.074	28	.120	34	.153
5	.012	11	.029	17	.057	23	.077	29	.124	35	.160
	.013	12	.033	18	.061	24	.082	30	.128	36	.167

FINENESS and VALUE of GOLD and SILVER, Computed.

The value per ounce of gold is based upon the simple *formula* that 387 ozs. of pure gold (1,000 fine) are worth $8,000. Hence, 1 oz. is worth $20.6718346253229974162067 *repetend;* and the 1-1000 of an oz, (decimally expressed as .001 fine) is worth $0.020671834625. What is usually called *fineness*, therefore, is simply the *weight* of *fine* metal contained in any given quantity of mixed metals or alloys. For instance, in a gold or silver bar which is reported to be 850 fine, it is meant that in 1000 parts *by weight*, 850 are *fine* gold or *fine* silver, as the case may be. In our mints, the value of gold is computed from *standard* weight; that is, gold which is 900 fine, that being the *fineness* of our gold coin as required by law. The *formula* in this case is, 43 ozs. of *standard* gold are worth $800. Hence, multiply standard ozs. by 800, and divide by 43, and you obtain the value. To find the value per oz., divide the total value by standard ozs. and you have the value of 1 oz. of gold 900 fine. To find the value of gold at any degree of fineness, multiply $20.671834 (which is the value of 1 oz. of gold 1000 fine) by the degree of fineness of which you wish to find the value. Example.—What is the value of 1 oz. of gold 90 fine? $20.6718×90 = $1.86.04620. The value of silver per oz. is computed from the formula that 99 ozs. of pure silver (1000 fine) are worth $128. Hence, 1 oz. is worth $1.29.29, etc., and the .001 of an oz. is worth $.000.129.29. And 11 ozs. of standard silver (900 fine) are worth $12.80, and hence, 1 oz. of standard silver is worth $1.16.36. These values, (*i. e.* $1.29 for fine silver and $1.16 for standard silver) are the *intrinsic* values of silver, being the values at which silver is equal to gold, dollar for dollar, or as $1 is to 15.98837, etc. Silver, however, usually commands a premium, which varies with the supply and demand. The premium allowed by the Branch Mint and other institutions on silver contained in gold deposits made for coinage, is four per cent. If 1 oz. of pure silver (1000 fine) is worth $1.29.29, 1 oz. of silver 900 fine is worth $1.16.36 (viz., $1.29.29×900). Hence, a silver bar weighing 1000 ozs, and containing 900 parts of silver, or 900 fine, multiplied by $1.16.36 equals $1,163.-60. Calculations of the value of metal may also be ascertained by reducing the proportions to fine gold and silver, and multiplying by the value per oz. of pure gold and pure silver. The following rule is applicable, viz., Gross weight multiplied by fineness, divided by 1000 gives net weight of pure metal.

EXAMPLE.—A bar 500 ozs. gross, 820 fine of gold, 170 fine of silver.

500×820=410 ozs. pure gold, at $20.67.18	$8,475 44
500×170=85 ozs. pure silver, at $1.29.29	109 89
Total value	$8,585 33

THE WORLD'S PRODUCTION OF GOLD AND SILVER.

From 1492 *to June* 30, 1881.*

COUNTRIES.	SILVER.	GOLD.	TOTAL.	ANNUAL PRODUCT'N.
Africa	$55,000,000	$334,325,340	$395,325,340	$6,000,000
America, N'th; B. Columbia	....	40,875,370	42,875,370	2,000,000
" " Mexico	2,675,280,659	135,174,396	2,826,455,055	16,000,000
" " United States	425,514,610	1,853,919,316	2,366,433,926	87,000,000
" South; Brazil	11,000,000	579,347,107	595,347,107	5,000,000
" " Bolivia (Potosi)	1,339,499,947	151,898,100	1,501,398,047	10,000,000
" " Chile	104,024,298	139,467,140	248,491,438	5,000,000
" " New Grenada	....	610,501,675	612,501.675	2,000,000
" " Peru	1,090,357,084	85,327,582	1,181,684,666	6,000,000
Australia	15,000,000	1,305,000,000	1,350,000,000	30,000,000
Europe, Austria—Hungary.	269,961,603	1,126,212,047	1,399,173,650	3,000,000
" Germany	274,731,339	9,000,000	287,731,339	4,000,000
" Russia	84,880,291	608,999,653	716,879,944	23,000,000
" Miscellaneous	256,388,604	40,000,000	298,388,604	2,000,000
Miscellaneous Countries	113,244,000	83,458,340	208,702,340	12,000,000
The World previous to 1492	3,434,000,000	5,257,374,000	8,691,374,000	....
Total	$10,148,882,435	$12,360,880,066	$22,722,762,501	$213,000,000

NOTE.—The aggregate amount of the precious metals at any period can only be estimated; that back of the present century, wild conjecture.

Authorities for the above table are: A. Soetbeer, Almanach de Gotha; Otreschkoff, Russian Counselor; J. J. Valentine, Pres. W. F. & Co., etc. The results are our own. EDITOR STATISTICIAN. * Add the Annual Production to future dates.

Abrasion.—On $1,000,000 shipped (from New York to Liverpool,) across the Atlantic, the abrasion will be about 16 ounces, or $256 16-96; and proportionately for larger amounts, and longer distances.

Assayers' Gold Weighn.

The unit is one-half of a gramme, subdivided into 1,000 parts.

Jewelers' Gold Weight.

1 Carat	=	10 Pwts. Troy.
1 Carat grain	=	2 Pwts. 12 grains or 60 grains Troy.
24 Carats	=	1 Pound Troy.

DIAMOND WEIGHT.

16 Parts	=	1 Grain	=	.8 Grain Troy
4 Grains	=	1 Carat	=	3.17 Grains Troy
20 Parts Diamond Weight			=	1 Grain Troy.

UNITED STATES COINAGE.

Gold and Silver when pure are 1,000 fine; or, by the old method 24 carats fine.

Except for jewelry the old carat system is generally abandoned. One carat = $41\frac{2}{3}$ thousandths.

The standard fineness of United States coin is 900; or, by the old system, $24 \times 900 = 21.6$ carats fine.

The alloy for United States gold coin is pure silver and copper; for silver coin the alloy is pure copper.

Gold for coinage is refined from 990 to $997\frac{1}{2}$ fine, the inferior metal it then holds being pure silver left for alloy.

When alloyed with copper the proportion of gold is in accordance with its fineness as the alloy must be 900 fine or $\frac{9}{10}$ pure gold.

For examples—

Suppose the refined gold to be 990 fine,—

$\frac{10}{11}$ parts gold, 990 fine = $\frac{9}{10}$ parts 1,000 fine.

Gold 990 fine, the inferior metal it holds being pure silver, and the alloy pure copper, the proportions for coin, 900 fine, would be—

$\frac{9}{10}$ pure gold + $\frac{1}{110}$ pure silver + $\frac{1}{11}$ pure copper = standard coin;

or, $\frac{10}{11}$ gold 990 fine + $\frac{1}{11}$ pure copper=standard coin

Suppose the refined gold to be 995 fine,—

$\frac{180}{199}$ parts gold 995 fine = $\frac{9}{10}$ parts 1,000 fine.

Gold 995 fine, the inferior metal it holds being pure silver, and the alloy pure copper, the proportions for coin, 900 fine, would be—

$\frac{9}{10}$ pure gold + $\frac{9}{1990}$ pure silver + $\frac{19}{199}$ pure copper=standard coin;

or, $\frac{180}{199}$ gold 995 fine + $\frac{19}{199}$ pure copper=standard coin.

MINT VALUES OF GOLD, SILVER AND COPPER.

1 Ounce gold	1,000 fine =	$20.6718346
1 Ounce silver	1,000 fine =	1.292929
1 Ounce Copper	1,000 fine =	.028571
1 Grain gold	1,000 fine =	.0430663
1 Grain silver,	1,000 fine =	.0026936
1 Grain copper	1,000 fine =	.0000595

The above values are standard as regards gold, those of silver and copper are only comparative as the prices at which the Mint buys the latter metals are changed from time to time according to their value in the market.

EXAMPLE 1—Required the Mint value of 11 ounces gold, 850 fine.

Solution. 11 (ounces) × .850 (fineness) ×20.671834 (Mint value per ounce) = $193.281245850 or $193.28 = **Mint value.**

EXAMPLE 2—Required the Mint value of 19 pennyweights 23 grains gold 785 fine.

Solution—Reduced to grains =479 (grains) ×.785 (fineness) ×$0.0430663 (Min' value per grain) =$16.1935747945 or $16.19=Mint value.

UNITED STATES MINT.

Deposit Melting Charge.

On bullion (or coin) below standard, and not required to be parted or refined:

For each melt of **1,000 ounces, or less**.......................................$1 00
Over 500 ounces.. One mill per ounce.

Parting and Refining Charges.

Parting Gold and Silver, or Refining Gold.—Rate per ounce gross of deposit.

Bullion containing not less than 200 M Gold			2 cents.
Bullion containing from 200 M to 399½ M Gold			3 "
"	"	" 400 M to 699½ M "	4 "
"	"	" 700 M and over "	6 "
"	"	over 100 M base metal, additional	½ cent.

And in addition to the above, on deposits requiring parting (except Silver Purchases), or Refining Gold:

For each deposit of 1,000 ounces or less...$1 00
" " " over 1,000 ounces.......................One mill per ounce, gross.

For gold coin or standard gold bars, the rate per ounce charge will be imposed only on the number of ounces required to be refined, to raise the whole to standard.

Silver allowed the depositor is calculated on the basis of refining the gold to 990 M.

Refining Silver.—Rate per Ounce gross of Deposit.

Bullion containing less than 897 M silver	2 cents.
897 M to 979½ M "	1½ "
980 M to 997½ M "	1 "

In addition to the above on silver deposits requiring refining (except purchases) a charge on each deposit of

1,000 ounces or less $1 00. Over 1,000 ounces, one mill per ounce gross.

The rate per ounce charge will be imposed only on the number of ounces required to be refined to raise the whole to standard.

Toughening Charge.—Gold Bullion.................. ½ to 2 cents per ounce gross.
Silver Bullion..... .... ¼ to 1 cent per ounce gross.

Alloy Charge.—On the number of ounces of copper required to reduce the bullion to standard, 2 cents per ounce troy.

Bar Charge.—On bullion deposited for Bars, and not required to be parted or refined:

Bars of fine gold per $100 value	10 cents.
" standard gold per $100 value	10 "
" fine silver per ounce fine	¼ cent.
" standard silver per ounce standard	½ "
" large silver per ounce gross	½ "
" unparted silver per ounce gross	½ "

No deposit of bullion is received of less value than one hundred dollars.

Assays of samples of ore and bullion are made at a charge of three dollars for each assay.

Waste in Coining, and Deviation in Weight.

The manufacture of coin is protected by a very efficient system, the employés of each department of the mint being held strictly responsible for all material received by them in accordance with certain allowances.

Waste—

Melters' and Refiners' allowance of Gold	1 ounce in 1000
Coiners' allowance of Gold	½ ounce in 1000
Melters' and Refiners' allowance of Silver	1½ ounce in 1000
Coiners' allowance of Silver	1 ounce in 1000

Deviation allowed from Standard Weight—

Twenty and Ten Dollar pieces	½ grain
Other gold pieces	¼ grain
Silver pieces	1½ grain

On each draft—

Of $5,000 gold, in $20, $10, $5 or $2½ pieces	.01 ounce
Of one thousand $3 or $1 gold pieces	.01 ounce
Of one thousand $1, 50 ct., or 25 ct. pieces	.02 ounce
Of one thousand dimes	.01 ounce

UNITED STATES MONEY.

10 Mills (M)	= 1 Cent	c.
10 Cents	= 1 Dime	d.
10 Dimes	= 1 Dollar	$.
10 Dollars	= 1 Eagle	E.

The Mill is one thousandth of a dollar and derives its name from the Latin word *mille*, which means a thousand.

The Cent is one hundredth of a dollar and derives its name from the Latin word *centum*, which means a hundred.

The Dime is one-tenth of a dollar and derives its name from the French word *disme*, which means ten.

UNITED STATES GOLD COINS PREVIOUS TO 1834.

Denomination.		Fineness.	Weight in Grains of Pure Metal.	Weight in Grains of Alloy.	Full Weight in Grains.	Value.
Eagle..........	$10.00	916⅔	247.5	22.5	270	$10.66
Half Eagle.....	5.00	916⅔	123.75	11.25	135	5.33
Quarter Eagle..	2.50	916⅔	61.875	5.625	67.5	2.66

UNITED STATES GOLD COINS SUBSEQUENT TO 1834.

Double Eagle...	$20.00	900	†464.4	51.6	516	$20.00
Eagle..........	10.00	900	232.2	25.8	258	10.00
Half Eagle.....	5.00	900	116.1	12.9	129	5.00
Three Dollars..	3.00	900	69.66	7.74	77.4	3.00
Quarter Eagle.	2.50	900	58.05	6.45	64.5	2.50
Dollar..........	1.00	900	23.22	2.58	25.8	1.00

UNITED STATES SILVER COINS PREVIOUS TO 1837.

Dollar.........	$1.00	892⅓	371.252	44.748	416	$1.06.9
Half Dollar	.50	892⅓	185.626	22.374	208	.53.4
Quarter Dollar.	.25	892⅓	92.813	11.187	104	.26.7
Dime.........	.10	892⅓	37.125	4.475	41.6	.10.6
Half Dime.....	.05	892⅓	18.563	2.237	20.8	.05.3

UNITED STATES SILVER COINS FROM 1837 TO 1853.

Dollar..........	$1.00	900	371.25	41.25	412 5	$1.06.9
Half Dollar	.50	900	185.626	20.625	206.251	.53.4
Quarter Dollar.	.25	900	92.813	10.312	103.125	.26.7
Dime...........	.10	900	37.125	4.125	41.250	.10.6
Half Dime.....	.05	900	18.563	2.062	20.625	.05.3
Three Cts. 1851.	.03	875	10.828	1.547	12.375	.03.1

UNITED STATES SILVER COINS SINCE 1853.

Trade Dollar...	$1.00	900	378	42	420	$1.08.9
Dollar	1.00	900	371.25	41.25	412 5	1.06.9
Half Dollar....	.50	900	173.61	19.29	192.90	.50
Quarter Dollar..	.25	900	86.805	9.645	96.45	.25
Twenty Cents*.	.20	900	69.444	7.716	77.16	.20
Dime...........	.10	900	34.722	3.858	38.58	.10
Half Dime*....	.05	900	17.361	1.929	19.29	.05
Three Cents*...	.03	900	10.413	1.157	11.57	.03

UNITED STATES COPPER COINS.

Denomination.	Act of	Grains of Copper.	Grains of Nickel.	Grains of Zinc.	Grains of Tin.	Full Weight in Grains.
Old Copper Ct.*	1793	168	....	....	....	168
One Cent.......	1864	45.6	....	1.44	.96	48
Two Cents*....	1865	91.2	4.8	....	....	96
Three Cents....	1865	24.	8	....	....	32
Five Cents.....	1866	57.87	19.29	....	....	77.16

* No longer coined. † Which is=$19.99998972 pure gold.

LEGAL TENDER.

The GOLD COINS of the United States are a legal tender in *all payments* at their nominal value when not below the standard weight and limit of tolerance, provided by law for the single piece; and when reduced in weight below such standard or tolerance are a legal tender at valuation in proportion to their actual weight.

LEGAL TENDER OF SILVER COINS.—Under the enactments of Congress the status of the silver coins is as follows:—The Trade Dollar is not legal tender for any purpose.

The Standard Silver Dollar is not a legal tender when otherwise expressed in a contract; and most contracts of any magnitude are now by business men made payable only in U. S. Gold Coin.

The Subsidiary Silver Coins, meaning the half dollar, the quarter dollar and the dime, are legal tender only to the amount of ten dollars.

It is a serious question whether under the Constitution of the United States, the Congress has power to demonetize the silver coins of the United States.

THE MINOR COINS.—The minor coins (nickels and coppers) are, under the congressional enactments, a legal tender to the amount of only twenty-five cents.

But under the U. S. Constitution it is very doubtful whether nickel, copper or any thing other than gold coin and silver coin can be made a legal tender, or in constitutional and proper language, "a tender in payment of debts."

No foreign gold or silver coins are a legal tender in the payment of debts.

ORIGIN OF THE DOLLAR.

The monetary unit of this country prior to July 6, 1785, was the English pound. On that date the Continental Congress established the dollar in its place, its precise weight and value being fixed August 6, 1786, which was about that of the old Spanish Carolus pillar dollar. The dollar was not original with Spain, its true origin being the "Joachim's Thaler," first coined in the mines of the Bohemian Valley of Sant Joachim.

ENGLISH MONEY.

4 Farthings (far.)	= 1 Penny d.
12 Pence	= 1 Shilling s.
20 Shillings	= 1 Pound £.

In England a pound of standard Troy gold, 916⅔ fine, is coined into £46 14s. 6d. The full weight of one gold pound or sovereign is 123.274 grains of standard gold, or 113.001 grains of pure gold.

Allowing for the abrasion or wear, a sovereign weighing 122.75 grains of standard gold, in England is a legal tender for the payment of debts.

The alloy for gold coin is copper. Before 1826 silver entered into the composition of English gold coin; hence, the difference in color of different coinages.

A pound of silver, 92.5 per cent silver and 7.5 copper, is coined into 66 shillings. The full weight of a shilling is 87.273 grains standard silver, or 80.729 grains of pure silver.

A pound of copper is coined into 24 pennies.

A pound of bronze, 95 parts copper, 4 parts tin and 1 part zinc, is coined into 40 pennies, or 80 half pennies, or 160 farthings.

Bank of England notes are a legal tender in England for any sum exceeding £5. Gold is a legal tender for any amount, silver, not exceeding 40 shillings, and copper not exceeding 12d, when in pennies or in half pennies, and not exceeding 6d when in farthings.

FRENCH MONEY.

10 Centimes	= 1 Decime.
10 Decimes	= 1 Franc.

All French coin is based on the *gramme*, the unit of weight.

A kilogramme of standard gold .9 pure is coined into 3,100 francs. The denominations of gold coin are 100, 50, 20, 10 and 5 franc pieces. The alloy is copper.

A kilogramme of silver .9 pure is coined into 200 francs. The denominations of silver coins are 5, 2, 1, ½ and ¼ franc pieces.

The copper coins of France since 1852 contain 95 parts copper, 4 parts tin and 1 part zinc. The denominations are 10, 5, 2 and 1 centimes, which weigh 1 gramme for each centime.

COMPARATIVE VALUES OF GOLD AND SILVER.

United States,	estimating	silver	1,	gold is	15.988.
England,	"	"	1,	"	14.287.
France,	"	"	1,	"	15.50.
Spain,	"	"	1,	"	16.00.
China,	"	"	1,	"	14.25.

In the United States we have a double standard; in Germany and England gold is the standard, and practically so in France and Italy; in most other European countries silver is the standard.

EQUIVALENTS OF ENGLISH AND UNITED STATES MONEY.

NOTE—The United States Mint valuation of the English sovereign, $4.86.6½, is the basis of these computations.

1d	$ .02*	5s 4d	$1.30	10s 7d	$2.57	15s 10d	$3.85
2	.04	5 5	1.32	10 8	2.59	15 11	3.87
3	.06	5 6	1.34	10 9	2.61	16	3 89
4	.08	5 7	1.36	10 10	2.63	16 1	3.91
5	.10	5 8	1.38	10 11	2.65	16 2	3.93
6	.12	5 9	1.40	11	2.68	16 3	3.95
7	.14	5 10	1.42	11 1	2.70	16 4	3 97
8	.16	5 11	1.44	11 2	2.72	16 5	3 99
9	.18	6	1.46	11 3	2.74	16 6	4.01
10	.20	6 1	1.48	11 4	2.76	16 7	4.03
11	.22	6 2	1.50	11 5	2.78	16 8	4 05
1s	.24*	6 3	1.52	11 6	2.80	16 9	4.07
1 1	.26	6 4	1.54	11 7	2.82	16 10	4.09
1 2	.28	6 5	1.56	11 8	2.84	16 11	4.11
1 3	.30	6 6	1.58	11 9	2.86	17	4.14
1 4	.32	6 7	1.60	11 10	2.88	17 1	4.16
1 5	.34	6 8	1.62	11 11	2.90	17 2	4.18
1 6	.36	6 9	1.64	12	2.92	17 3	4.20
1 7	.38	6 10	1.66	12 1	2.94	17 4	4.22
1 8	.40	6 11	1.68	12 2	2.96	17 5	4.24
1 9	.42	7	1.70	12 3	2.98	17 6	4.26
1 10	.44	7 1	1.72	12 4	3.00	17 7	4.28
1 11	.46	7 2	1.74	12 5	3 02	17 8	4.30
2	.49	7 3	1.76	12 6	3.04	17 9	4.32
2 1	.51	7 4	1.78	12 7	3.06	17 10	4 34
2 2	.53	7 5	1.80	12 8	3.08	17 11	4.36
2 3	.55	7 6	1.82	12 9	3.10	18	4.38
2 4	.57	7 7	1.84	12 10	3.12	18 1	4.40
2 5	.59	7 8	1.86	12 11	3.14	18 2	4.42
2 6	.61	7 9	1.88	13	3.16	18 3	4.44
2 7	.63	7 10	1.90	13 1	3.18	18 4	4.46
2 8	.65	7 11	1.92	13 2	3.20	18 5	4.48
2 9	.67	8	1.95	13 3	3.22	18 6	4.50
2 10	.69	8 1	1.97	13 4	3.24	18 7	4.52
2 11	.71	8 2	1.99	13 5	3.26	18 8	4.54
3	.73	8 3	2.01	13 6	3.28	18 9	4.56
3 1	.75	8 4	2.03	13 7	3.30	18 10	4.58
3 2	.77	8 5	2.05	13 8	3.32	18 11	4.60
3 3	.79	8 6	2.07	13 9	3.34	19	4.62
3 4	.81	8 7	2.09	13 10	3.36	19 1	4.64
3 5	.83	8 8	2.11	13 11	3.38	19 2	4.66
3 6	.85	8 9	2.13	14	3.41	19 3	4.68
3 7	.87	8 10	2.15	14 1	3.43	19 4	4.70
3 8	.89	8 11	2.17	14 2	3.45	19 5	4.72
3 9	.91	9	2.19	14 3	3.47	19 6	4.74
3 10	.93	9 1	2.21	14 4	3.49	19 7	4.76
3 11	.95	9 2	2.23	14 5	3.51	19 8	4.78
4	.97	9 3	2.25	14 6	3.53	19 9	4.80
4 1	.99	9 4	2.27	14 7	3.55	19 10	4.82
4 2	1 01	9 5	2.29	14 8	3.57	19 11	4.84
4 3	1.03	9 6	2.31	14 9	3.59	£1	4.87
4 4	1.05	9 7	2.33	14 10	3.61	1 .. 1	4.89
4 5	1.07	9 8	2.35	14 11	3.63	1 .. 2	4.91
4 6	1.09	9 9	2.37	15	3.65	1 .. 3	4.93
4 7	1.11	9 10	2.39	15 1	3.67	1 .. 4	4.95
4 8	1.13	9 11	2.41	15 2	3.69	1 .. 5	4.97
4 9	1.15	10	2.43	15 3	3.71	1 .. 6	4.99
4 10	1.17	10 1	2.45	15 4	3.73	1 .. 7	5.01
4 11	1.19	10 2	2 47	15 5	3.75	1 .. 8	5.03
5	1.22	10 3	2.49	15 6	3.77	1 .. 9	5.05
5 1	1.24	10 4	2.51	15 7	3.79	1 .. 10	5.07
5 2	1.26	10 5	2.53	15 8	3.81	1 .. 11	5.09
5 3	1.28	10 6	2.55	15 9	3.83	1 1 ..	5.11

*1 penny=2 $\frac{133}{4800}$ cents. 1 shilling=24 $\frac{133}{400}$ cents.

EQUIVALENTS OF ENGLISH AND U. S. MONEY—CONTINUED.

£1	1s	1d	$5.13	£1	6s	10d	$6.53	£1	12s	7d	$7.93	£1	18s	4d	$9.33
1	1	2	5.15	1	6	11	6.55	1	12	8	7.95	1	18	5	9.35
1	1	3	5.17	1	7		6.57	1	12	9	7.97	1	18	6	9.37
1	1	4	5.19	1	7	1	6.59	1	12	10	7.99	1	18	7	9.39
1	1	5	5.21	1	7	2	6.61	1	12	11	8.01	1	18	8	9.41
1	1	6	5.23	1	7	3	6.63	1	13		8.03	1	18	9	9.43
1	1	7	5.25	1	7	4	6.65	1	13	1	8.05	1	18	10	9.45
1	1	8	5.27	1	7	5	6.67	1	13	2	8.07	1	18	11	9.47
1	1	9	5.29	1	7	6	6.69	1	13	3	8.09	1	19		9.49
1	1	10	5.31	1	7	7	6.71	1	13	4	8.11	1	19	1	9.51
1	1	11	5.33	1	7	8	6.73	1	13	5	8.13	1	19	2	9.53
1	2		5.35	1	7	9	6.75	1	13	6	8.15	1	19	3	9.55
1	2	1	5.37	1	7	10	6.77	1	13	7	8.17	1	19	4	9.57
1	2	2	5.39	1	7	11	6.79	1	13	8	8.19	1	19	5	9.59
1	2	3	5.41	1	8		6.81	1	13	9	8.21	1	19	6	9.61
1	2	4	5.43	1	8	1	6.83	1	13	10	8.23	1	19	7	9.63
1	2	5	5.45	1	8	2	6.85	1	13	11	8.25	1	19	8	9.65
1	2	6	5.47	1	8	3	6.87	1	14		8.27	1	19	9	9.67
1	2	7	5.49	1	8	4	6.89	1	14	1	8.29	1	19	10	9.69
1	2	8	5.51	1	8	5	6.91	1	14	2	8.31	1	19	11	9.71
1	2	9	5.53	1	8	6	6.93	1	14	3	8.33	2	..	..	9.73
1	2	10	5.55	1	8	7	6.95	1	14	4	8.35	2	..	1	9.75
1	2	11	5.57	1	8	8	6.97	1	14	5	8.37	2	..	2	9.77
1	3		5.59	1	8	9	6.99	1	14	6	8.39	2	..	3	9.79
1	3	1	5.62	1	8	10	7.01	1	14	7	8.41	2	..	4	9.81
1	3	2	5.64	1	8	11	7.03	1	14	8	8.43	2	..	5	9.83
1	3	3	5.66	1	9		7.05	1	14	9	8.45	2	..	6	9.85
1	3	4	5.68	1	9	1	7.08	1	14	10	8.47	2	..	7	9.87
1	3	5	5.70	1	9	2	7.10	1	14	11	8.49	2	..	8	9.89
1	3	6	5.72	1	9	3	7.12	1	15		8.51	2	..	9	9.91
1	3	7	5.74	1	9	4	7.14	1	15	1	8.54	2	..	10	9.93
1	3	8	5.76	1	9	5	7.16	1	15	2	8.56	2	..	11	9.95
1	3	9	5.78	1	9	6	7.18	1	15	3	8.58	2	1		9.97
1	3	10	5.80	1	9	7	7.20	1	15	4	8.60	2	1	1	10.00
1	3	11	5.82	1	9	8	7.22	1	15	5	8.62	2	1	2	10.02
1	4		5.84	1	9	9	7.24	1	15	6	8.64	2	1	3	10.04
1	4	1	5.86	1	9	10	7.26	1	15	7	8.66	2	1	4	10.06
1	4	2	5.88	1	9	11	7.28	1	15	8	8.68	2	1	5	10.08
1	4	3	5.90	1	10		7.30	1	15	9	8.70	2	1	6	10.10
1	4	4	5.92	1	10	1	7.32	1	15	10	8.72	2	1	7	10.12
1	4	5	5.94	1	10	2	7.34	1	15	11	8.74	2	1	8	10.14
1	4	6	5.96	1	10	3	7.36	1	16		8.76	2	1	9	10.16
1	4	7	5.98	1	10	4	7.38	1	16	1	8.78	2	1	10	10.18
1	4	8	6.00	1	10	5	7.40	1	16	2	8.80	2	1	11	10.20
1	4	9	6.02	1	10	6	7.42	1	16	3	8.82	2	2		10.22
1	4	10	6.04	1	10	7	7.44	1	16	4	8.84	2	2	1	10.24
1	4	11	6.06	1	10	8	7.46	1	16	5	8.86	2	2	2	10.26
1	5		6.08	1	10	9	7.48	1	16	6	8.88	2	2	3	10.28
1	5	1	6.10	1	10	10	7.50	1	16	7	8.90	2	2	4	10.30
1	5	2	6.12	1	10	11	7.52	1	16	8	8.92	2	2	5	10.32
1	5	3	6.14	1	11		7.54	1	16	9	8.94	2	2	6	10.34
1	5	4	6.16	1	11	1	7.56	1	16	10	8.96	2	2	7	10.36
1	5	5	6.18	1	11	2	7.58	1	16	11	8.98	2	2	8	10.38
1	5	6	6.20	1	11	3	7.60	1	17		9.00	2	2	9	10.40
1	5	7	6.22	1	11	4	7.62	1	17	1	9.02	2	2	10	10.42
1	5	8	6.24	1	11	5	7.64	1	17	2	9.04	2	2	11	10.44
1	5	9	6.26	1	11	6	7.66	1	17	3	9.06	2	3		10.46
1	5	10	6.28	1	11	7	7.68	1	17	4	9.08	2	3	1	10.48
1	5	11	6.30	1	11	8	7.70	1	17	5	9.10	2	3	2	10.50
1	6		6.32	1	11	9	7.72	1	17	6	9.12	2	3	3	10.52
1	6	1	6.35	1	11	10	7.74	1	17	7	9.14	2	3	4	10.54
1	6	2	6.37	1	11	11	7.76	1	17	8	9.16	2	3	5	10.56
1	6	3	6.39	1	12		7.78	1	17	9	9.18	2	3	6	10.58
1	6	4	6.41	1	12	1	7.81	1	17	10	9.20	2	3	7	10.60
1	6	5	6.43	1	12	2	7.83	1	17	11	9.22	2	3	8	10.62
1	6	6	6.45	1	12	3	7.85	1	18		9.24	2	3	9	10.64
1	6	7	6.47	1	12	4	7.87	1	18	1	9.27	2	3	10	10.66
1	6	8	6.49	1	12	5	7.89	1	18	2	9.29	2	3	11	10.68
1	6	9	6.51	1	12	6	7.91	1	18	3	9.31	2	4		10.70

EQUIVALENTS OF ENGLISH AND U. S. MONEY—Continued.

Note—This continuation of the preceding tables includes only pounds sterling. To ascertain the equivalent of an amount expressed in pounds, shillings and pence, to the amount given in this page for pounds add the equivalent for shillings and pence as shown in the preceding tables.

£ 1	$ 4.86.6½	£ 66	$321.18.9	£131	$637.51.1½	£196	$ 953.83.4
2	9.73.3	67	326.05.5½	132	642.37.8	197	958.70.0½
3	14.59.9½	68	330.92.2	133	647.24.4½	198	963.56.7
4	19.46.6	69	335.78.8½	134	652.11.1	199	968.43.3½
5	24.33 2½	70	340.65.5	135	656.97.7½	200	973.30
6	29.19.9	71	345.52.1½	136	661.84.4	201	978.16.6½
7	34.06.5½	72	350.38.8	137	666.71.0½	202	983.03.3
8	38.93.2	73	355.25.4½	138	671.57.7	203	987.89.9½
9	43.79.8½	74	360.12.1	139	676.44.3½	204	992.76.6
10	48.66.5	75	364.98.7½	140	681.31	205	997.63.2½
11	53.53.1½	76	369.85.4	141	686.17.6½	206	1,002.49.9
12	58.39.8	77	374.72.0½	142	691.04.3	207	1,007.36.5½
13	63.26.4½	78	379 58.7	143	695.90.9½	208	1,012.23.2
14	68.13.1	79	384.45.3½	144	700.77 6	209	1,017.09.8½
15	72.99.7½	80	389.32	145	705.64.2½	210	1,021.96.5
16	77.86.4	81	394.18.6½	146	710.50.9	211	1,026.83.1½
17	82.73.0½	82	399.05.3	147	715.37.5½	212	1,031.69.8
18	87.59.7	83	403.91.9½	148	720.24.2	213	1,036.56.4½
19	92.46.3½	84	408.78.6	149	725.10.8½	214	1,041.43.1
20	97.33	85	413.65.2½	150	729.97.5	215	1,046.29.7½
21	102.19.6½	86	418.51.9	151	734.84.1½	216	1,051.16.4
22	107.06.3	87	423.38.5½	152	739.70.8	217	1,056.03.0½
23	111.92.9½	88	428.25.2	153	744.57.4½	218	1,060.89.7
24	116.79.6	89	433.11.8½	154	749.44.1	219	1,065.76.3½
25	121.66.2½	90	437.98.5	155	754.30.7½	220	1,070.63
26	126.52.9	91	442.85.1½	156	759.17.4	211	1,075.49.6½
27	131.39.5½	92	447.71.8	157	764.04.0½	222	1,080.36.3
28	136.26.2	93	452.58.4½	158	768.90.7	223	1,085.22.9½
29	141.12.8½	94	457.45.1	159	773.77.3½	224	1,090.09.6
30	145.99.5	95	462.31.7½	160	778.64	225	1,094.96.2½
31	150.86.1½	96	467.18.4	161	783.50.6½	226	1,099.82.9
32	155.72.8	97	472.05.0½	162	788.37.3	227	1,104.69.5½
33	160.59.4½	98	476.91.7	163	793.23.9½	228	1,109.56.2
34	165.46.1	99	481.78.3½	164	798.10.6	229	1,114.42.8½
35	170.32.7½	100	486.65	165	802.97.2½	230	1,119.29.5
36	175.19.4	101	491.51.6½	166	807.83.9	231	1,124.16.1½
37	180.06.0½	102	496.38.3	167	812.70.5½	232	1,129.02.8
38	184.92.7	103	501.24.9½	168	817.57.2	233	1,133.89.4½
39	189.79.3½	104	506.11.6	169	822.43.8½	234	1,138.76.1
40	194.66	105	510.98.2½	170	827.30.5	235	1,143.62.7½
41	199.52.6½	106	515.84.9	171	832.17 1½	236	1,148.49.4
42	204.39.3	107	520.71.5½	172	837.03.8	237	1,153.36.0½
43	209.25.9½	108	525.58.2	173	841.90.4½	238	1,158.22.7
44	214.12.6	109	530.44.8½	174	846.77.1	239	1,163.09.3½
45	218.99 2½	110	535.31.5	175	851.63.7½	240	1,167.96.
46	223.85.9	111	540.18.1½	176	856.50.4	241	1,172.82.6½
47	228.72.5½	112	545.04.8	177	861.37.0½	242	1,177.69.3
48	233.59.2	113	549.91.4½	178	866.23.7	243	1,182.55.9½
49	238.45.8½	114	554.78.1	179	871.10.3½	244	1,187.42.6
50	243.32.5	115	559.64.7½	180	875.97.	245	1,192.29.2½
51	248.19.1½	116	564.5[illegible].4	181	880.83.6½	246	1,197.15.9
52	253.05.8	117	569.38.0½	182	885.70.3	247	1,202.02.5½
53	257.92.4½	118	574.24.7	183	890.56.9½	248	1,206.89.2
54	262.79.1	119	579.11.3½	184	895.43.6	249	1,211.75.8½
55	267.65.7½	120	583.98	185	900.30.2½	250	1,216.62.5
56	272.52.4	121	588.84.6½	186	905.16.9	251	1,221.49.1½
57	277.39.0½	122	593.71.3	187	910.03.5½	252	1,226.35.8
58	282.25.7	123	598.57.9½	188	914.90.2	253	1,231.22.4½
59	287.12.3½	124	603.44.6	189	919.76.8½	254	1,236.09.1
60	291.99	125	608.31.2½	190	924.63.5	255	1,240.95.7½
61	296.85.6½	126	613.17.9	191	929.50.1½	256	1,245.82.4
62	301.72.3	127	618.04.5½	192	934.36.8	257	1,250.69.0½
63	306.58.9½	128	622.91.2	193	939.23.4½	258	1,255.55.7
64	311.45.6	129	627.77.8½	194	944.10.1	259	1,260.42.3½
65	316.32.2½	130	632.64.5	195	948.96.7½	260	1,265.29.

EQUIVALENTS OF FRENCH AND UNITED STATES MONEY.

NOTE—The United States Mint valuation of the franc, 19.3 cents, is here used. 100 centimes make one franc. French money is denoted as follows: 64 francs and 72 centimes, written—fr. 64.72.

1c	$.00.2	16c	$.03.1	31c	$.06.0	46c	$.08.9	61c	$.11.8	76c	$.14.7	91c	$.17 5
2	.00.4	17	.03.3	32	.06.2	47	.09.1	62	.12.0	77	.14.8	92	.17.7
3	.00.6	18	.03.5	33	.06.4	48	.09.3	63	.12.1	78	.15.0	93	.17.9
4	.00.8	19	.03.7	34	.06.5	49	.09.4	64	.12.3	79	.15.2	94	.18.1
5	.01.0	20	.03.8	35	.06.7	50	.09 6	65	.12.5	80	.15.4	95	.18.3
6	.01.1	21	.04.0	36	.06.9	51	.09.8	66	.12.7	81	.15.6	96	.18.5
7	.01.3	22	.04.2	37	.07.1	52	.10.0	67	.12.9	82	15.8	97	.18.7
8	.01.5	23	.04.4	38	.07.3	53	.10.2	68	.13.1	83	.16.0	98	.18.9
9	.01.7	24	.04.6	39	.07.5	54	.10.4	69	.13.3	84	.16.2	99	.19.1
10	.01.9	25	.04.8	40	.07.7	55	.10.6	70	.13.5	85	.16.4	100	.19.3
11	.02.1	26	.05.0	41	.07.9	56	.10.8	71	.13.7	85	.16.6	....	......
12	.02.3	27	.05.2	42	.08.1	57	.11.0	72	.13.9	87	.16.8	....	.....
13	.02.5	28	.05.4	43	.08.3	58	.11.2	73	.14.1	88	.17.0	....	......
14	.02.7	29	.05.6	44	.08.5	59	.11.4	74	.14.3	89	.17.2	....	......
15	.02.9	30	.05.8	45	.08.7	60	.11.6	75	.14.5	90	.17.4	....	......

1fr	$ .19.3	51fr	$ 9.84.3	101fr	$19.49.3	151fr	$29.14.3	fr. 100	$ 19.30
2	.38.6	52	10.03.6	102	19.68.6	152	29.33.6	200	38.60
3	.57.9	53	10.22.9	103	19.87.9	153	29.52.9	300	57.90
4	.77.2	54	10.42.2	104	20.07.2	154	29.72.2	400	77.20
5	.96.5	55	10.61.5	105	20.26.5	155	29.91.5	500	96.50
6	1.15.8	56	10.80.8	106	20.45.8	156	30.10.8	600	115.80
7	1.35.1	57	11.00.1	107	20.65.1	157	30.30.1	700	135.10
8	1.54.4	58	11.19.4	108	20.84.4	158	30.49.4	800	154.40
9	1.73.7	59	11.38.7	109	21.03.7	159	30.68.7	900	173.70
10	1.93.0	60	11.58.0	110	21.23.0	160	30.88.0	1,000	193.00
11	2.12.3	61	11.77.3	111	21.42 3	161	31.07.3	2 000	386.00
12	2.31.6	62	11.96.6	112	21.61.6	162	31.26.6	3,000	579.00
13	2.50.9	63	12.15.9	113	21.80 9	163	31.45.9	4,000	772.00
14	2.70.2	64	12.35.2	114	22.00.2	164	31.65.2	5,000	965.00
15	2.89.5	65	12.54.5	115	22.19.5	165	31.84.5	6,000	1,158.00
16	3.08.8	66	12.73.8	116	22.38.8	166	32.03.8	7,000	1,351.00
17	3.28.1	67	12.93.1	117	22.58.1	167	32.23.1	8,000	1,544.00
18	3.47.4	68	13.12.4	118	22.77.4	168	32.42.4	9,000	1,737.00
19	3.66.7	69	13.31.7	119	22.96.7	169	32 61.7	10,000	1,930.00
20	3.86.0	70	13.51.0	120	23.16.0	170	32.81.0	20,000	3,860.00
21	4.05.3	71	13.70.3	121	23.35.3	171	33.00.3	30,000	5,790.00
22	4.24.6	72	13.89.6	122	23.54.6	172	33.19.6	40,000	7,720.00
23	4.43.9	73	14.08.9	123	23.73.9	173	33.38.9	50,000	9,650.00
24	4.63.2	74	14.28.2	124	23.93.2	174	33 58.2	60,000	11,580.00
25	4.82.5	75	14.47.5	125	24.12.5	175	33.77.5	70,000	13,510.00
26	5.01.8	76	14.66.8	126	24.31.8	176	33.96.8	80,000	15,440.00
27	5.21.1	77	14.86.1	127	24.51.1	177	34.16.1	90,000	17,370.00
28	5.40.4	78	15.05.4	128	24.70.4	178	34.35.4	100,000	19,300.00
29	5.59.7	79	15.24.7	129	24.89.7	179	34.54.7	200,000	38,600.00
30	5.79 0	80	15.44.0	130	25.09.0	180	34.74.0	300,000	57,900.00
31	5.98.3	81	15.63.3	131	25.28.3	181	34.93.3	400,000	77,200.00
32	6.17.6	82	15.82.6	132	25.47.6	182	35.12.6	500,000	96,500.00
33	6.36.9	83	16.01.9	133	25.66.9	183	35.31.9	600,000	115,800 00
34	6.56.2	84	16.21.2	134	25.86.2	184	35.51.2	700,000	135,100.00
35	6.75.5	85	16.40.5	135	26.05.5	185	35.70.5	800,000	154,400.00
36	6.94.8	86	16.59.8	136	26.24.8	186	35.89.8	900,000	173,700.00
37	7.14.1	87	16.79.1	137	26.44.1	187	36.09.1	1,000,000	193,000.00
38	7.33.4	88	16.98.4	138	26.63.4	188	36.28.4	2,000,000	386,000.00
39	7.52.7	89	17.17.7	139	26.82.7	189	36.47.7	3,000,000	579,000.00
40	7.72.0	90	17.37.0	140	27.02.0	190	36.67.0	4,000,000	772,000.00
41	7.91.3	91	17.56.3	141	27.21.3	191	36.86.3	5,000,000	965,000.00
42	8.10.6	92	17.75.6	142	27.40.6	192	37.05.6	6,000,000	1,158,000.00
43	8.29.9	93	17.94.9	143	27.59.9	193	37.24.9	7,000,000	1,351,000.00
44	8.49.2	94	18.14.2	144	27.79.2	194	37.44.2	8,000,000	1,544,000.00
45	8.68.5	95	18.33.5	145	27.98.5	195	37.63.5	9,000,000	1,737,000.00
46	8.87.8	96	18.52.8	146	28.17.8	196	37.82.8	10,000,000	1,930,000.00
47	9.07.1	97	18.72.1	147	28.37.1	197	38 02.1	20,000,000	3,860,000.00
48	9.26.4	98	18.91.4	148	28.56.4	198	38.21.4	30,000,000	5,790,000 00
49	9.45.7	99	19.10.7	149	28.75.7	199	38.40.7	40,000,000	7,720,000.00
50	9.65.0	100	19.30.0	150	28.95.0	200	38 60.0	50,000,000	9,650,000.00

Foreign Coins.

Chilean Gold Coins.

Denomination.		Value.	Weight in Grains.			Diameter.	
Name.	Fineness.	Pesos.	Pure Metal.	Alloy.	Full Weight.	Millimetres.	Inches.
Condor	.900	$10.00	211.850	23.523	235.374	28.5	1.122045
Doblon	.900	5.00	105.925	11.777	117.702	22.0	.866140
Escudo	.900	2.00	42.369	4.714	47.084	16.5	.649605
Peso	.900	1.00	21.184	2.350	23.534	14.0	.551180

Chilean Silver Coins.

Peso	.900	1.00	347.227	38.580	385.808	37.0	1.45669
Medio Peso	.900	.50	173.613	19.290	192.904	30.0	1.18110
Quinto	.900	.20	69.445	7.716	77.161	23.0	.90651
Decimo	.900	.10	34.336	4.243	38.580	18.0	.70866
Medio Decimo	.900	.05	17.361	1.929	19.290	15.0	.59055

Chilean Copper Coins.

Dos Centavos	Cop. .95 Nic. .05	.02	102.625	5.401	108.026	25.0	.98425
Un Centavo		.01	51.3125	25.8495	77.162	21.0	.82677
Medio Centavo		.005	25.65625	20.64075	46.297	19.0	.74803

Chinese Money and Equivalents.

The Director of the U. S. Mint reported January 1, 1897, that the value of the haikwan or customs tael of China, based on the same price of silver that was used in estimating the values of foreign silver coins, proclaimed in the circular of January 1, 1897, at the various Chinese ports, is as follows:—

Port.	Value.	Port.	Value.	Port.	Value.	Port.	Value.
Amoy	$0.76 7	Chin Kiang	$0.74 9	Niuchwang	$0.71 9	Swatow	$0.70 8
Canton	.76 5	Fuchau	.70 9	Ningpo	.73 7	Takao	.77 2
Chefoo	.73 3	Hankow	.71 7	Shanghai	.70 0	Tien-Tsin	.74 3

Money Weights.	Equiv't in Mex. Coin.	Money Weights.	Equiv't in Mex. Coin.
10 Hao=1 Li= 1⅓ copper cash =	$0.001⅓ Peso	10 Fen =1 Tsien= 133⅓ copper cash =	$0.13⅓ Peso
10 Li =1 Fen=13⅓ copper cash =	0.01⅓ Peso	10 Tsien=1 Liang= 1,133⅓ copper cash =	1.33⅓ Peso

Japanese Gold Coins.

Denomination.		Fineness.	Weight in Grains of			Value in U.S. Gold Coin.
			Pure Metal.	Alloy.	Full Weight	
One Yen	$ 1.00	900	11.57	1.29	12.86	$ 0.49–86
2 Yen	2.00	900	23.14	2.58	25.72	.99–72
5 Yen	5.00	900	57.85	6.45	64.30	2.49–30
10 Yen	10.00	900	115.70	12.90	128.60	4.98–60
20 Yen	20.00	900	231.40	25.80	257.20	9.97–20

Japanese Silver Coins.

Denomination.		Fineness.	Weight in Grains of			Value in U.S. Gold Coin.
			Pure Metal.	Alloy.	Full Weight	
5 Sen	$ .05	900	18.7375	2.0625	20.8	$ 0.04 38
10 Sen	.10	900	37.475	4.125	41.6	0.08 76
20 Sen	.20	900	74.950	8.250	83.2	0.17 52
50 Sen	.50	900	187.375	20.625	208.0	0.43 8
1 Yen	1.00	900	374.75	41.25	416.0	0.87 6
Trade Yen	1.01	900	378.00	42.00	420.0	0.88 6

Japanese Copper Coins.

Denomination.		Act of	Weight in Grains of		Value in Yens.
			Pure Metal.	Full Weight.	
1 Rin =	$ 0.0025	1871	27.507	27.507	$ 0.0025
½ Sen=	0.005	1871	55.014	55.014	0.005
1 Sen =	0.01	1871	110.028	110.028	0.01
2 Sen =	0.02	1871	220.056	220.056	0.02

Note.—The $ mark of the U.S. is used in Japan to designate the Yen.

Mexican Coins.

NOTE—The metric system of weights and measures became compulsory in Mexico, January 1st, 1884.

Coinage.—The principal coinage is of silver, consisting in every 12 dineros of of 10 5-6 dineros of pure metal (1000 fine) and 1 1-6 dinero of alloy; that is, it is 0.902,777 fine. The monetary unit is the *peso*. The gold coinage is not in general circulation; the fineness of the "Old Doubloon" is 870, the "Twenty Pesos" of the Republic, (new) 873, and the "Twenty Pesos" of the Empire, 875 fine. The so called nickel coins vary from 20 to 25 per cent. of nickel and 75 to 80 per cent. of copper. Pesos continue to be struck with the legend 8R, meaning 8 reales. The piece of 50 centavos is called 4 reales, also *tosten*. That of 25 centavos, 2 reales, also *peseta*.

MEXICAN * GOLD COINS.

DENOMINATION.	Fineness	Value in Pesos.	Weight in Grammes	Weight in Troy ozs.	Diameter in Mil'mtrs	Diameter in Inches.
Double Hidalgo.......	875	$ 20.00	33.841	1.0860	34	1.33858
Hidalgo	875	10.00	16.920	.5430	27	1.06299
Medio Hidalgo........	875	5.00	8.460	.2715	22	.86614
Cuarto Hidalgo.......	875	2.50	4.230	.13575	18	.70866
Décimo Hidalgo......	875	1.00	1.692	.05430	15	.59055

MEXICAN * SILVER COINS.

Peso.................	901	1.00	27.073	0.866	37	1.45669
50 centavos.	901	.50	13.536	0.433	30	1.18110
25 centavos.	901	.25	6.768	0.2165	25	.98425
10 centavos.	901	.10	2.707	.0866	17	.66929

MEXICAN * NICKEL (AND COPPER) COINS.

5 centavos	see note above	.05	5.	.16075	20	.78740
2 centavos		.02	3.	.09645	18	.70866
1 centavo		.01	2.	.06430	16	.62992

* There were formerly coined in gold the *onza*, =$16 in silver; the *real*,=$0.12½; *medio real*, = $0.06¼; *cuartilla*, = $0.03⅛. And in copper the *tlaco*, = $0.01 9-16; *centavo*, = $0.01. The *grano*, as a monetary unit, was 1-96 of a *peso*, or 1-12 of a *real*.

Russian Coinage and Money.

The Silver Rouble is the legal unit of money in Russia, and must contain as such 278 grains, or 4 *Zolotnicks* and 21 *Dolis*, of fine silver. The principal circulating medium is paper money, in 3, 5, 10, 25, 50 and 100 Roubles; the *issue* of 50 Roubles has been withdrawn from circulation, on account of its being extensively counterfeited, and easily accomplished.

GOLD COINS.

DENOMINATION.	Fineness.	Weight, oz.	Equivalent, Eng.	Equivalent, U. S.
½ Imperial = 5 Roubles	916	0.210	= 16 shillings....	= $3.89
1 Imperial = 10 Roubles	916	0.420	= 32 shillings....	= 7.78

SILVER OOINS.

DENOMINATION.	Fineness.	Pure Silver Grains.	Equivalent, Eng.	Equivalent, U. S.
1 Piatachek = 5 Kopeks...	875	13.9	= 1 penny, 3 far.	= $0.03548
1 Grivenik = 10 Kopeks...	875	27.8	= 3 pence, 2 "	= 0.07096
1 Dvougrivenni = 20 Kopeks...	875	55.6	= 7 "	= 0.14192
1 Tchetvertak = 25 Kopeks...	875	69.5	= 8 " 3 "	= 0.17740
1 Poltina = 50 Kopeks...	875	139.	= 1 s. 5 p. 2 far..	= 0.35480
1 Rouble =100 Kopeks...	875	278.	= 2 s. 11 p..	= 0.70960

COPPER COINS.

DENOMINATION.	Equivalent, Eng.	Equivalent, U. S.
1 Poloushka = ¼ Kopek......	= .35 far.	= $0.001774
2 Poloushka = 1 Grosh = ½ Kopek......	= .7 far.	= 0.003548
2 Grosh = 1 Kopeika = 1 Kopek.......	= 1.4 far.	= 0.007096
2 Kopeika = 1 Dvoukopeechnik = 2 Kopeks......	= 2.8 far.	= 0.014192
3 Kopeika = 1 Trehkopeechnik = 3 Kopeks......	= 4.2 far.	= 0.021288
5 Kopeika = 1 Piatak = 5 Kopeks......	= 1 penny 3 far.	= 0.03548

Estimate of Values of Foreign Coins in U. S. Money, Proclaimed by the Treasury Department, January 1, 1907.

NOTE.—The "standard" of a given country is indicated as follows: *G. & S.* where its standard silver coins are unlimited legal tender, the same as its gold coins; *single gold* or *single silver*, as its standard coins of one or the other metal are unlimited legal tender. The par of exchange of the monetary unit of a country with a single gold, or a double standard is fixed at the value of the gold unit as compared with the United States gold unit. In the case of a country with a single silver standard, the par of exchange is computed at the mean price of silver in the London market for a period commencing Oct. 1 and ending Dec. 24, each year, as per daily cable dispatches to the Bureau of the Mint.

Country.	Standard.	Monetary unit.	Value.	Coins.
Argentine Republic	G. & S.	Peso	$0.96 5	Gold, Argentine ($4.82 4) and ½ Argentine; silver, peso and div.
Austria-Hungary	Gold	Crown	.20 3	(*a*)Gold, present sys'm—20 crowns ($4.05 2), 10 crowns ($2.02 6).
Belgium	G. & S.	Franc	.19 3	Gold, 10 & 20 frs.; silver, 5 frs.& div.
Bolivia	Silver	Boliviano	.43 1	Silver, Boliviano and divisions.
Brazil	Gold	Milreis	.54 6	Gold, 5, 10 & 20 m.; silver, 2 m.&div.
Br. Poss. N.A.	Gold	Dollar	1.00	Newfoundland, gold dollar ($1.00).
Br. Honduras	Gold	Dollar	1.00	
C. A. States‖	Silver	Peso	.43 1	Silver, Peso and divisions.
Chile	Gold	Peso	.36 5	Gold, Condor ($9.12 3 & ½ Condor Escudo ($1.82 4).
China	Silver	Tael, Shanghai Tael, Customs	.64 5 .71 9	There are no G. & S. coins in China; the tael denotes a sum of money.
Colombia U. S. of	Silver	Peso Dollar	.42 4 1.00	Gold, Condor ($9.64 7) and double condor.
Costa Rica	Silver Gold	Peso Colon	.43 1 .46 5	Silver, Peso and divisions.
Cuba	G. & S.	Peso	.91 0	Gold, Doubloon ($5.01 7); silver peso.
Denmark	Gold	Crown	.26 8	Gold, 10 and 20 crowns.
Ecuador	Silver Gold	Sucre	.46 8 .48 7	Gold, Condor ($9.64 7) and double condor.
Egypt	Gold	Pound §	4.94 3	Gold, Pound & div.; S., 20 pi. & div.
Finland	Gold	Mark	.19 3	Gold, 20 marks ($3.85 9) & divisions.
France	G. & S.	Franc	.19 3	Gold, 5, 10, 20, 50, 100 fr.; S., 5 fr.&div.
Germany	Gold	Mark	.23 8	Gold, 5, 10 and 20 marks.
Great Britain	Gold	Pound Sterli'g	4.86 6½	Gold, Sovereign (£ ster.) & ½ sov'n.
Greece	G. & S.	Drachma	.19 3	Gold, 5, 10, 20, 50, 100 dr.; silver, 5 dr.
Haiti	G. & S.	Gourde	.96 5	Silver, Gourde and divisions.
India‡	Silver Gold	Rupee.	.32 4 .32 4	Gold, Mohur ($7.10 5); S., rupee & div.
Italy	G. & S.	Lira	.19 3	Gold, 5, 10, 20, 50, 100 liras; S. 5 l.& div.
Japan	G. & S.*	Yen Gold Yen Silver	.49 8 .50 5	Gold, 1, 2, 5, 10 and 20 yen. Silver, Yen and divisions.
Liberia	Gold	Dollar	1.00	Gold, $1.00.
Mexico	Silver	Dollar	.46 8	Gold, Peso ($0.98 3) 2½, 5, 10, 20 pesos.
Netherlands	G. & S.	Florin	.40 2	Gold, 10 florins; S. ½, 1, 2½ florins.
Newfoundl'd.	Gold	Dollar	1.01 4	Gold, 2 dollars ($2.02 7).
Norway	Gold	Crown	.26 8	Gold, 10 and 20 crowns.
Persia	Silver	Kran	.07 9	Silver, 1, 5 and 10 krans.
Peru	Silver	Sol	.48 7	Silver, Sol and divisions.
Philippine Is.	Gold	Peso	.50	Silver, peso and divisions.
Portugal	Gold	Milreis	1.08	Gold, 1, 2, 5, 10 m.; S., 1 m. and div.
Russia	Silver*b*	Rouble	.51 5 .37 4	†Gold, Imperial ($7.71 8) & ½ imp. Silver, 1 rouble and divisions.
Spain	G. & S.	Peseta	.19 3	Gold, 25 pesetas; S. 5 pes. and div.
Sweden	Gold	Crown	.26 8	Gold, 10 and 20 crowns.
Switzerland	G. & S.	Franc	.19 3	Gold, 5, 10, 20, 50, 100 fr.; S., fr & div.
Tripoli	Silver	Mahbub	.44 2	Silver, Mahbub of 20 piastres.
Turkey	Gold	Piaster	.04 4	Gold, 25, 50, 100, 200, 500 piastres.
Uruguay	Gold	Peso	1.03 4	Gold, 1, 5, 10 and 20 pesos.
Venezuela	G. & S.	Bolivar	.19 3	Gold, 5, 10, 20, 50, 100 bol.; S., 5 bol.

*Gold the nominal standard; silver the practical one.

†Half imperials before 1886 ($3.98 6). ‡One lac rupees=100,000 rupees. The Br. Sovereign is the standard coin of India, but the rupee is the money of account, current at 15 to the sovereign.

‖Central American States, Costa Rica, Guatemala, Honduras, Nicaragua, and Salvador. §One pound is divided into 100 piastres.

*a*Gold: former system—8 florins ($3.85 8), ducats ($2.28 7), and 4 ducats ($9.15 8); silver, 1 and 2 florins.

*b*Silver the nominal standard. Paper the actual currency, the depreciation of which is measured by the gold standard. The rouble=100 kopecks.

The coins of Belgium, Finland, France, Greece, Italy, Spain, and Switzerland are of equal value, though differently named; these countries form the Latin monetary union.

COMMERCIAL RATIO OF SILVER TO GOLD FOR EACH YEAR SINCE 1687.

[NOTE.—From 1687 to 1832 the ratios are taken from the tables of Dr. A. Soetbeer; from 1833 to 1878 from Pixley and Abell's tables; and from 1878 to date from daily cablegrams from London to the Bureau of the Mint.]

Year.	Ratio.	Year.	Ratio.	Year.	Ratio.	Year.	Ratio.	Year.	Ratio.
1687......	14.94	1729......	14.92	1771......	14.66	1813......	16.25	1855......	15.38
1688......	14.94	1730......	14.81	1772......	14.52	1814.....	**15.04**	1856......	15.38
1689......	15.02	1731......	14.94	1773.....	14.62	1815......	15.26	1857......	15.27
1690......	15.02	1732.....	15.09	1774......	14.62	1816......	15.28	1858......	15.38
1691......	14.98	1733......	15.18	1775......	14.72	1817......	15.11	1859......	**15.19**
1692......	14.92	1734......	15.39	1776......	14.55	1818......	15.35	1860......	15.29
1693......	14.83	1735......	15.41	1777......	14.54	1819......	15.33	1861......	15.50
1694......	1[illegible].87	1736......	15.18	1778......	14.68	1820......	15.62	1862......	15.35
1695......	15.02	1737.....	15.02	1779......	14.80	1821......	15.95	1863......	15.37
1696......	15.00	1738......	14.91	1780......	14.72	1822......	15.80	1864......	15.37
1697......	15.20	1739......	14.91	1781......	14.78	1823......	15.84	1865......	15.44
1698......	15.07	1740......	14.94	1782......	14.42	1824......	15.82	1866......	15.43
1699......	14.94	1741......	14.92	1783......	14.48	1825.....	15.70	1867......	15.57
1700......	14.81	1742......	14.85	1784......	14.70	1826......	15.76	1868......	15.59
1701......	15.07	1743......	14.85	1785......	14.92	1827....	15.74	1869......	15.60
1702......	15.52	1744......	14.87	1786......	14.96	1828......	15.78	1870	15.57
1703......	15.17	1745......	14.98	1787......	14.92	1829......	15.78	1871......	15.57
1704......	15.22	1746......	15.13	1788......	14.65	1830......	15.82	1872......	15.63
1705......	15.11	1747......	15.26	1789......	14.75	1831......	15.72	1873......	15.92
1706......	15.27	1748......	15.11	1790......	15.04	1832......	15.73	1874......	16.17
1707......	15.44	1749......	14.80	1791......	15.05	1833......	15.93	1875......	16.59
1708......	15.41	1750.....	14.55	1792......	15.17	1834......	15.73	1876......	17.88
1709......	15.31	1751......	14.39	1793......	15.00	1835......	15.80	1877......	17.22
1710......	15.22	1752......	14.54	1794......	15.37	1836.....	15.72	1878......	17.94
1711......	15.29	1753	14.54	1795......	15.55	1837......	15.83	1879......	18.40
1712......	15.31	1754	14.48	1796......	15.65	1838......	15.85	1880......	18.05
1713......	15.24	1755......	14.68	1797......	15.41	1839.....	15.62	1881......	18.16
1714......	15.13	1756......	14.94	1798......	15.59	1840......	15.62	1882.....	18.19
1715......	15.11	1757......	14.87	1799......	15.74	1841......	15.70	1883......	18.64
1716......	15.09	1758......	14.85	1800......	15.68	1842......	15.87	1884......	18.57
1717......	15.13	1759......	14.15	1801......	15.46	1843......	15.93	1885......	19.41
1718......	15.11	1760......	**14.14**	1802......	15.26	1844......	15.85	1886......	20.78
1719......	15.09	1761......	14.54	1803......	15.41	1845......	15.92	1887......	21.13
1720......	15.04	1762......	15.27	1804......	15.41	1846......	15.90	1888......	21.99
1721......	15.05	1763......	14.99	1805......	15.79	1847......	15.80	1889......	22.09
1722......	15.17	1764......	14.70	1806......	15.52	1848......	15.85	1890......	19.76
1723......	15.20	1765......	14.83	1807......	15.43	1849......	15.78	1891......	20.92
1724......	15.11	1766......	14.80	1808......	16.08	1850......	15.70	1892......	23.72
1725.....	15.11	1767.....	14.85	1809.....	15.96	1851......	15.46	1893......	26.49
1726......	15.15	1768......	14.80	1810......	15.77	1852......	15.59	1894......	**32.56**
1727......	15.24	1769......	14.72	1811......	15.53	1853......	15.33	1895......	31.60
1728......	15.11	1770......	14.62	1812......	16.11	1854......	15.33	1896......	*30.66

NOTE.—By the above table it will be seen that the highest price silver has reached in the last 205 years (or since 1687), was in 1760; the highest during this century was 1814; and the highest since 1818, was in 1859.

An International Monetary Conference met at Brussels, Belgium, on Nov. 22, 1892, to consider the silver question, bimetalism, etc. The following 14 countries were represented with from one to eleven delegates each, viz:—Austria, Belgium, Denmark, France, Germany, Great Britain, Italy, Mexico, Netherlands, Spain, Sweden and Norway, Russia, Switzerland, and the United States. The conference adjourned on Dec. 18, 1892, after holding some 20 sessions; they did nothing whatever, no new light was thrown upon the subject. The only delegates who appeared to be masters of the question were the American. The Rothschild who was a member did not figure as a great financier. The English delegates generally appeared to be obstructionists. One of them wanted to adjourn almost before ideas had been exchanged. The French, who were expected to rally around the double standard, proved a disappointment. There was no cordial alliance between them and the delegates of the U. S., though the two republics, in a sense, maintain the same monetary system. Austria, with its new-born ambition to return to specie payments in gold after a century of paper, could not, of course, be shaken. Germany contributed little to the elucidation of the question. Soetbeer, a German financier, made the only suggestion that came from that nation, though he did not speak officially—that is to say, to increase the ratio from 15½ grains silver to 20 grains silver for 1 grain of gold.

* For 1897, ratio, 34.28; for 1898, ratio, 35.03; for 1899, ratio, 34.36; for 1900, ratio, 33.33; for 1901, ratio, 34.68; for 1902, ratio, **39.15**; for 1903, ratio, 38.10.

Price of Silver in London, per Ounce, British Standard (.925), since 1833, and the equivalent in U. S. Gold Coin of an Ounce 1,000 Fine, Taken at the average Price.

Calendar Year.	Quotations. Lowest.	High-est.	Aver-age.	Value of a fine oz. at average quotation.	Calendar Year.	Quotations. Lowest.	High-est.	Aver-age.	Value of a fine oz. at average quotation
	d.	*d.*	*d.*	*Dollars.*		*d.*	*d.*	*d.*	*Dollars.*
1833..	58.75	59.875	59.1875	1.297	1866..	60.375	62.25	61.125	1.339
1834..	59.75	60.75	59.9375	1.313	1867..	60.375	61.25	60.5625	1.328
1835..	59.25	60.	59.6875	1.308	1868..	60.125	61.125	60.5	1.326
1836..	59.625	60.375	60.	1.315	1869..	60.	61.	60.5	1.325
1837..	59.	60.375	59.5625	1.305	1870..	60.25	60.75	60.5625	1.328
1838..	59.5	60.125	59.5	1.304	1871..	60.375	61.	60.5	1.326
1839..	60.	60.625	60.375	1.323	1872..	59.25	61.125	60.625	1.322
1840..	60.125	60.75	60.375	1.323	1873..	57.875	59.9375	59.25	1.298
1841..	59.75	60.375	60.0625	1.316	1874..	57.5	59.5	58.625	1.278
1842..	59.25	60.	59.875	1.303	1875..	59.5	57.625	56.875	1.246
1843..	59.	59.625	59.375	1.297	1876..	46.75	58.5	52.75	1.156
1844..	59.25	59.75	59.5	1.304	1877..	53.25	58.25	54.8125	1.201
1845..	58.875	59.875	59.25	1.298	1878..	49.5	55.25	52.5625	1.152
1846..	59.	60.125	59.625	1.300	1879..	48.875	53.75	51.25	1.123
1847..	58.875	60.375	59.6875	1.308	1880..	51.625	52.875	52.25	1.145
1848..	58.5	60.	59.5	1.304	1881..	50.875	52.875	51.9375	1.138
1849..	59.5	60.	59.75	1.309	1882..	50.	52.375	51.8125	1.136
1850..	59.5	61.5	61.0625	1.316	1883..	50.	51.375	50.625	1.110
1851..	60.	61.625	61.	1.337	1884..	49.5	51.375	50.75	1.113
1852..	59.875	61.875	60.5	1.326	1885..	46.875	50.	48.5625	1.0645
1853..	60.625	61.875	61.5	1.348	1886..	42.	47.	45.375	0.9946
1854..	60.875	61.875	61.5	1.348	1887..	43.25	47.125	44.625	0.97823
1855..	60.	61.625	61.625	1.344	1888..	41.625	44.5625	42.875	0.93987
1856..	60.6	62.25	61.625	1.344	1889..	42.	44.375	42.6875	0.93576
1857..	61.	62.375	61.75	1.353	1890..	43.625	54.625	47.75	1.04633
1858..	60.75	61.875	61.625	1.344	1891..	43.5	48.75	45.0625	0.98782
1859..	61.75	***62.75**	62.0625	**1.360**	1892..	37.875	43.75	39.75	.87106
1860..	61.25	62.375	61.6875	1.352	1893..	30.50	38.75	35.5625	.78031
1861..	60.125	61.375	60.8125	1.333	1894..	**†27.**	31.75	28.875	.63479
1862..	61.	62.125	61.875	1.346	1895..	27.187	31.375	29.8125	.65406
1863..	61.	61.75	61.375	1.345	1896..	29.75	31.9375	30.75	.67437
1864..	60.625	62.5	61.375	1.345	1897..	23.625	29.8125	27.5625	.60354
1865..	60.5	61.625	61.0625	1.338	1898..	25.	28.5	26.9375	.59010

* Highest quotation reached since 1833. †Lowest quotation in 200 years occurred in July, 1893.

NOTE.—The ratio that gold and silver bore to each other in Egypt and Babylon. The researches of Prof. Brugesch prove the ratio of gold to silver in ancient Egypt was 1 to 12½. Dr. Brandes has shown that in Babylon the ratio was always 1 to 13.0303.

Value of the Silver in a Silver Dollar, Reckoned at the Commercial Price of Silver Bullion from 80 cents to $1.2929 (parity), per Fine Ounce.

Pure Silver, 1,000 fine. At price per fine ounce.	Value in a Silver Dollar.	Pure Silver, 1,000 fine. At price per fine ounce.	Value in a Silver Dollar.	Pure Silver, 1,000 fine. At price per fine ounce.	Value in a Silver Dollar.	Pure Silver, 1,000 fine. At price per fine ounce.	Value in a Silver Dollar.
$0.80	$0.619	$0.93	$0.719	$1.06	$0.820	$1.19	$0.920
.81	.626	.94	.727	1.07	.828	1.20	.928
.82	.634	.95	.735	1.08	.835	1.21	.936
.83	.642	.96	.742	1.09	.843	1.22	.944
.84	.649	.97	.750	1.10	.851	1.23	.951
.85	.657	.98	.758	1.11	.859	1.24	.959
.86	.665	.99	.766	1.12	.866	1.25	.967
.87	.673	1.00	.773	1.13	.874	1.26	.975
.88	.681	1.01	.781	1.14	.882	1.27	.982
.89	.688	1.02	.789	1.15	.889	1.28	.990
.90	.696	1.03	.797	1.16	.897	1.29	.998
.91	.704	1.04	.804	1.17	.905	1.2929	1.000
92	.712	1.05	.812	1.18	.913		

INTEREST.

In calculating interest it is customary to consider the month as the twelfth part of a year; and each day as the thirtieth part of a month, when interest is calculated on any number of days less than a month. The tables under this head are computed on this basis.

RULES FOR COMPUTING INTEREST.

1. To compute interest at 6 % when the time is in months or years.

Rule—Multiply the principal by the number of months; if there are no cents in the principal point off two decimals; if there are cents in the principal point off four decimals and divide the product by 2.

Example—Determine the interest on $400 for 2 years and 4 months at 6 %

2 years and 4 months are 28 months.

$28 \times 400 = 11200$

$112.00 \div 2 = \$56.00$, the interest required.

2. To compute interest at 6 % when the time is in days.

Rule—Multiply the principal by the number of days; if there are no cents in the principal point off three decimals; if there are cents in the principal point off five decimals; and divide the product by 6.

Example—Determine the interest on $700 for 330 days at 6 %

$330 \times 700 = 231.000$

$231.00 \div 6 = \$38.50$, the interest required.

3. To compute interest at 6 % when the time is given in years or months and days.

Rule—Call one-half the number of months cents and one-sixth of the number of days mills; and multiply their sum by the principal.

Example—Determine the interest on $600 for 1 year, 4 months, and 18 days at 6 %

one-half of 16 months..............................	.08
one-sixth of 18 days..............................	.003
	.083
multiply by principal..............................	600
the interest required	$49.80

4. To compute interest at various rates.

Rule—Find the interest at 6 % according to the above rules, and for other rates, compute therefrom, as follows:

For 3 % divide by 2
" 4 % subtract ⅓
" 5 % " 1-6
" 7 % add 1-6
" 8 % " ⅓
" 9 % " ½
" 10 % multiply by 10 and divide by 6
" 11 % multiply by 2 and subtract 1-12
" 12 % " 2

Example—Determine the interest on $900 for 1 year, 4 months and 18 days at 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12 %

one-half of 16 months..............................	.08
one-sixth of 18 days..............................	.003
	.083
multiply by principal..............................	900
interest at 6 %..............................	$74.70

	2) 74.70
Interest at 3 %..................	$37.35
	3) 74.70
	24.90
Interest at 4 %..................	$49.80
	6) 74.70
	12.45
Interest at 5 %..................	$62.25
	6) 74.70
	12.45
Interest at 7 %..................	$87.15
	3) 74.70
	24.90
Interest at 8 %..................	$99.60

	2) 74.70
	37.35
Interest at 9 %..................	$112.05
	6) 747.00
Interest at 10 %..................	$124.50
	74.70
	2
	12) 149.40
	12.45
Interest at 11 %..................	$136.95
	74.70
	2
Interest at 12 %..................	$149.40

INTEREST TABLES.

NOTE—These tables show the interest on **one dollar** for the given time; the amounts being expressed in decimals of a dollar.

TIME.	½ % PER MONTH	¾ % PER MONTH	⅞ % PER MONTH	1 % PER MONTH	1⅛ % PER MONTH	1¼ % PER MONTH
1 Day.	.00016667	.00025	.00029167	.00033333	.000375	.00041667
2 " .	.00033333	.0005	.00058333	.00066667	.00075	.00083333
3 " .	.0005	.00075	.000875	.001	.001125	.00125
4 " .	.00066667	.001	.00116667	.00133333	.0015	.00166667
5 " .	.00083333	.00125	.00145833	.00166667	.001875	.00208333
6 " .	.001	.0015	.00175	.002	.00225	.0025
7 " .	.00116667	.00175	.00204167	.00233333	.002625	.00291667
8 " .	.00133333	.002	.00233333	.00266667	.003	.00333333
9 " .	.0015	.00225	.002625	.003	.003375	.00375
10 " .	.00166667	.0025	.00291667	.00333333	.00375	.00416667
11 " .	.00183333	.00275	.00320833	.00366667	.004125	.00458333
12 " .	.002	.003	.0035	.004	.0045	.005
13 " .	.00216667	.00325	.00379167	.00433333	.004875	.00541667
14 " .	.00233333	.0035	.00408333	.00466667	.00525	.00583333
15 " .	.0025	.00375	.004375	.005	.005625	.00625
16 " .	.00266667	.004	.00466667	.00533333	.006	.00666667
17 " .	.00283333	.00425	.00495833	.00566667	.006375	.00708333
18 " .	.003	.0045	.00525	.006	.00675	.0075
19 " .	.00316667	.00475	.00554167	.00633333	.007125	.00791667
20 " .	.00333333	.005	.00583333	.00666667	.0075	.00833333
21 " .	.0035	.00525	.006125	.007	.007875	.00875
22 " .	.00366667	.0055	.00641667	.00733333	.00825	.00916667
23 " .	.00383333	.00575	.00670833	.00766667	.008625	.00958333
24 " .	.004	.006	.007	.008	.009	.01
25 " .	.00416667	.00625	.00729167	.00833333	.009375	.01041667
26 " .	.00433333	.0065	.00758333	.00866667	.00975	.01083333
27 " .	.0045	.00675	.007875	.009	.010125	.01125
28 " .	.00466667	.007	.00816667	.00933333	.0105	.01166667
29 "	.00483333	.00725	.00845833	.00966667	.010875	.01208333
1 Month	.005	.0075	.00875	.01	.01125	.0125

TIME.	1⅜ % PER MONTH	1½ % PER MONTH	1⅝ % PER MONTH	1¾ % PER MONTH	1⅞ % PER MONTH	2 % PER MONTH
1 Day.	.00045833	.0005	.00054167	.00058333	.000625	.00066667
2 " .	.00091667	.001	.00108333	.00116667	.00125	.00133333
3 " .	.001375	.0015	.001625	.00175	.001875	.002
4 " .	.00183333	.002	.00216667	.00233333	.0025	.00266667
5 " .	.00229167	.0025	.00270833	.00291667	.003125	.00333333
6 " .	.00275	.003	.00325	.0035	.00375	.004
7 " .	.00320833	.0035	.00379167	.00408333	.004375	.00466667
8 " .	.00366667	.004	.00433333	.00466667	.005	.00533333
9 " .	.004125	.0045	.004875	.00525	.005625	.006
10 " .	.00458333	.005	.00541667	.00583333	.00625	.00666667
11 " .	00504167	.0055	.00595833	.00641667	.006875	.00733333
12 " .	.0055	.006	.0065	.007	.0075	.008
13 " .	.00595833	.0065	.00704167	.00758333	.008125	.00866667
14 " .	.00641667	.007	.00758333	.00816667	.00875	.00933333
15 " .	.006875	.0075	.08125	.00875	.009375	.01
16 " .	.00733333	.008	.0866667	.00933333	.01	.01066667
17 " .	.00779167	.0085	.0920833	.00991667	.010625	.01133333
18 " .	.00825	.009	.0975	.0105	.01125	.012
19 " .	.00870833	.0095	.01029167	.01108333	.011875	.01266667
20 " .	.00916667	.01	.01083333	.01166667	.0125	.01333333
21 " .	.009625	.0105	.011375	.01225	.013125	.014
22 " .	.01008333	.011	.01191667	.01283333	.01375	.01466667
23 " .	.01054167	.0115	.01245833	.01341667	.014375	.01533333
24 " .	.011	.012	.013	.014	.015	.016
25 " .	.01145833	.0125	.01354167	.01458333	.015625	.01666667
26 " .	.01191667	.013	.01408333	.01516667	.01625	.01733333
27 " .	.012375	.0135	.014625	.01575	.016875	.018
28 " .	.01283333	.014	.01516667	.01633333	.0175	.01866667
29 " .	.01329167	.0145	.01570833	.01691667	.018125	.01933333
1 Month	.01375	.015	.01625	.0175	.01875	.02

INTEREST TABLES—Continued.

Note—These tables show the interest on **one dollar** from one day to one year, advancing by days, the amounts being expressed in decimals of a dollar.

Time. M.	D.	5 % per year	6 % per year	7 % per year	8 % per year	9 % per year	10 % per year	11 % per year	12 % per year
	1.	.0001389	.0001667	.0001944	.0002222	.00025	.0002778	.0003056	.0003333
	2.	.0002778	.0003333	.0003889	.0004444	.0005	.0005556	.0006111	.0006667
	3.	.0004167	.0005	.0005833	.0006667	.00075	.0008333	.0009167	.001
	4.	.0005556	.0006667	.0007778	.0008889	.001	.0011111	.0012222	.0013333
	5.	.0006944	.0008333	.0009722	.0011111	.00125	.0013889	.0015278	.0016667
	6.	.0008333	.001	.0011667	.0013333	.0015	.0016667	.0018333	.002
	7.	.0009722	.0011667	.0013611	.0015556	.00175	.0019444	.0021389	.0023333
	8.	.0011111	.0013333	.0015556	.0017778	.002	.0022222	.0024444	.0026667
	9.	.00125	.0015	.00175	.002	.00225	.0025	.00275	.003
	10.	.0013889	.0016667	.0019444	.0022222	.0025	.0027778	.0030556	.0033333
	11.	.0015278	.0018333	.0021389	.0024444	.00275	.0030556	.0033611	.0036667
	12.	.0016667	.002	.0023333	.0026667	.003	.0033333	.0036667	.004
	13.	.0018056	.0021667	.0025278	.0028889	.00325	.0036111	.0039722	.0043333
	14.	.0019444	.0023333	.0027222	.0031111	.0035	.0038889	.0042778	.0046667
	15.	.0020833	.0025	.0029167	.0033333	.00375	.0041667	.0045833	.005
	16.	.0022222	.0026667	.0031111	.0035556	.004	.0044444	.0048889	.0053333
	17.	.0023611	.0028333	.0033056	.0037778	.00425	.0047222	.0051944	.0056667
	18.	.0025	.003	.0035	.004	.0045	.005	.0055	.006
	19.	.0026389	.0031667	.0036944	.0042222	.00475	.0052778	.0058056	.0063333
	20.	.0027778	.0033333	.0038889	.0044444	.005	.0055556	.0061111	.0066667
	21.	.0029167	.0035	.0040833	.0046667	.00525	.0058333	.0064167	.007
	22.	.0030556	.0036667	.0042778	.0048889	.0055	.0061111	.0067222	.0073333
	23.	.0031944	.0038333	.0044722	.0051111	.00575	.0063889	.0070278	.0076667
	24.	.0033333	.004	.0046667	.0053333	.006	.0066667	.0073333	.008
	25.	.0034722	.0041667	.0048611	.0055556	.00625	.0069444	.0076389	.0083333
	26.	.0036111	.0043333	.0050556	.0057778	.0065	.0072222	.0079444	.0086667
	27.	.00375	.0045	.00525	.006	.00675	.0075	.00825	.009
	28.	.0038889	.0046667	.0054444	.0062222	.007	.0077778	.0085556	.0093333
	29.	.0040278	.0048333	.0056389	.0064444	.00725	.0080556	.0088611	.0096667
1	...	.0041667	.005	.0058333	.0066667	.0075	.0083333	.0091667	.01
1	1.	.0043056	.0051667	.0060278	.0068889	.00775	.0086111	.0094722	.0103333
1	2.	.0044444	.0053333	.0062222	.0071111	.008	.0088889	.0097778	.0106667
1	3.	.0045833	.0055	.0064167	.0073333	.00825	.0091667	.0100833	.011
1	4.	.0047222	.0056667	.0066111	.0075556	.0085	.0094444	.0103889	.0113333
1	5.	.0048611	.0058333	.0068056	.0077778	.00875	.0097222	.0106944	.0116667
1	6.	.005	.006	.007	.008	.009	.01	.011	.012
1	7.	.0051389	.0061667	.0071944	.0082222	.00925	.0102778	.0113056	.0123333
1	8.	.0052778	.0063333	.0073889	.0084444	.0095	.0105556	.0116111	.0126667
1	9.	.0054167	.0065	.0075833	.0086667	.00975	.0108333	.0119167	.013
1	10.	.0055556	.0066667	.0077778	.0088889	.01	.0111111	.0122222	.0133333
1	11.	.0056944	.0068333	.0079722	.0091111	.01025	.0113889	.0125278	.0136667
1	12.	.0058333	.007	.0081667	.0093333	.0105	.0116667	.0128333	.014
1	13.	.0059722	.0071667	.0083611	.0095556	.01075	.0119444	.0131389	.0143333
1	14.	.0061111	.0073333	.0085556	.0097778	.011	.0122222	.0134444	.0146667
1	15.	.00625	.0075	.00875	.01	.01125	.0125	.01375	.015
1	16.	.0063889	.0076667	.0089444	.0102222	.0115	.0127778	.0140556	.0153333
1	17.	.0065278	.0078333	.0091389	.0104444	.01175	.0130556	.0143611	.0156667
1	18.	.0066667	.008	.0093333	.0106667	.012	.0133333	.0146667	.016
1	19.	.0068056	.0081667	.0095278	.0108889	.01225	.0136111	.0149722	.0163333
1	20.	.0069444	.0083333	.0097222	.0111111	.0125	.0138889	.0152778	.0166667
1	21.	.0070833	.0085	.0099167	.0113333	.01275	.0141667	.0155833	.017
1	22.	.0072222	.0086667	.0101111	.0115556	.013	.0144444	.0158889	.0173333
1	23.	.0073611	.0088333	.0103056	.0117778	.01325	.0147222	.0161944	.0176667
1	24.	.0075	.009	.0105	.012	.0135	.015	.0165	.018
1	25.	.0076389	.0091667	.0106944	.0122222	.01375	.0152778	.0168056	.0183333
1	26.	.0077778	.0093333	.0108889	.0124444	.014	.0155556	.0171111	.0186667
1	27.	.0079167	.0095	.0110833	.0126667	.01425	.0158333	.0174167	.019
1	28.	.0080556	.0096667	.0112778	.0128889	.0145	.0161111	.0177222	.0193333
1	29.	.0081944	.0098333	.0114722	.0131111	.01475	.0163889	.0180278	.0196667
2	...	.0083333	.01	.0116667	.0133333	.015	.0166667	.0183333	.02
2	1.	.0084722	.0101667	.0118611	.0135556	.01525	.0169444	.0186389	.0203333
2	2.	.0086111	.0103333	.0120556	.0137778	.0155	.0172222	.0189444	.0206667
2	3.	.00875	.0105	.01225	.014	.01575	.0175	.01925	.021
2	4.	.0088889	.0106667	.0124444	.0142222	.016	.0177778	.0195556	.0213333

INTEREST TABLES—CONTINUED.

TIME. M.	D.	5 % PER YEAR	6 % PER YEAR	7 % PER YEAR	8 % PER YEAR	9 % PER YEAR	10 % PER YEAR	11 % PER YEAR	12 % PER YEAR
2	5.	.0090278	.0108333	.0126389	.0144444	.01625	.0180556	.0198611	.0216667
2	6.	.0091667	.011	.0128333	.0146667	.0165	.0183333	.0201667	.022
2	7.	.0093056	.0111667	.0130278	.0148889	.01675	.0186111	.0204722	.0223333
2	8.	.0094444	.0113333	.0132222	.0151111	.017	.0188889	.0207778	.0226667
2	9.	.0095833	.0115	.0134167	.0153333	.01725	.0191667	.0210833	.023
2	10.	.0097222	.0116667	.0136111	.0155556	.0175	.0194444	.0213889	.0233333
2	11.	.0098611	.0118333	.0138056	.0157778	.01775	.0197222	.0216944	.0236667
2	12.	.01	.012	.014	.016	.018	.02	.022	.024
2	13.	.0101389	.0121667	.0141944	.0162222	.01825	.0202778	.0223056	.0243333
2	14	.0102778	.0123333	.0143889	.0164444	.0185	.0205556	.0226111	.0246667
2	15.	.0104167	.0125	.0145833	.0166667	.01875	.0208333	.0229167	.025
2	16.	.0105556	.0126667	.0147778	.0168889	.019	.0211111	.0232222	.0253333
2	17.	.0106944	.0128333	.0149722	.0171111	.01925	.0213889	.0235278	.0256667
2	18.	.0108333	.013	.0151667	.0173333	.0195	.0216667	.0238333	.026
2	19.	.0109722	.0131667	.0153611	.0175556	.01975	.0219444	.0241389	.0263333
2	20.	.0111111	.0133333	.0155556	.0177778	.02	.0222222	.0244444	.0266667
2	21.	.01125	.0135	.01575	.018	.02025	.0225	.02475	.027
2	22.	.0113889	.0136667	.0159444	.0182222	.0205	.0227778	.0250556	.0273333
2	23.	.0115278	.0138333	.0161389	.0184444	.02075	.0230556	.0253611	.0276667
2	24.	.0116667	.014	.0163333	.0186667	.021	.0233333	.0256667	.028
2	25.	.0118056	.0141667	.0165278	.0188889	.02125	.0236111	.0259722	.0283333
2	26.	.0119444	.0143333	.0167222	.0191111	.0215	.0238889	.0262778	.0286667
2	27.	.0120833	.0145	.0169167	.0193333	.02175	.0241667	.0265833	.029
2	28.	.0122222	.0146667	.0171111	.0195556	.022	.0244444	.0268889	.0293333
2	29.	.0123611	.0148333	.0173056	.0197778	.02225	.0247222	.0271944	.0296667
3	...	.0125	.015	.0175	.02	.0225	.025	.0275	.03
3	1.	.0126389	.0151667	.0176944	.0202222	.02275	.0252778	.0278056	.0303333
3	2.	.0127778	.0153333	.0178889	.0204444	.023	.0255556	.0281111	.0306667
3	3.	.0129167	.0155	.0180833	.0206667	.02325	.0258333	.0284167	.031
3	4.	.0130556	.0156667	.0182778	.0208889	.0235	.0261111	.0287222	.0313333
3	5.	.0131944	.0158333	.0184722	.0211111	.02375	.0263889	.0290278	.0316667
3	6.	.0133333	.016	.0186667	.0213333	.024	.0266667	.0293333	.032
3	7.	.0134722	.0161667	.0188611	.0215556	.02425	.0269444	.0296389	.0323333
3	8.	.0136111	.0163333	.0190556	.0217778	.0245	.0272222	.0299444	.0326667
3	9	.01375	.0165	.01925	.022	.02475	.0275	.03025	.033
3	10.	.0138889	.0166667	.0194444	.0222222	.025	.0277778	.0305556	.0333333
3	11.	.0140278	.0168333	.0196389	.0224444	.02525	.0280556	.0308611	.0336667
3	12.	.0141667	.017	.0198333	.0226667	.0255	.0283333	.0311667	.034
3	13.	.0143056	.0171667	.0200278	.0228889	.02575	.0286111	.0314722	.0343333
3	14.	.0144444	.0173333	.0202222	.0231111	.026	.0288889	.0317778	.0346667
3	15.	.0145833	.0175	.0204167	.0233333	.02625	.0291667	.0320833	.035
3	16.	.0147222	.0176667	.0206111	.0235556	.0265	.0294444	.0323889	.0353333
3	17.	.0148611	.0178333	.0208056	.0237778	.02675	.0297222	.0326944	.0356667
3	18.	.015	.018	.021	.024	.027	.03	.033	.036
3	19.	.0151389	.0181667	.0211944	.0242222	.02725	.0302778	.0333056	.0363333
3	20.	.0152778	.0183333	.0213889	.0244444	.0275	.0305556	.0336113	.0366667
3	21.	.0154167	.0185	.0215833	.0246667	.02775	.0308333	.0339167	.037
3	22.	.0155556	.0186667	.0217778	.0248889	.028	.0311111	.0342222	.0373333
3	23.	.0156944	.0188333	.0219722	.0251111	.02825	.0313889	.0345278	.0376667
3	24.	.0158333	.019	.0221667	.0253333	.0285	.0316667	.0348333	.038
3	25.	.0159722	.0191667	.0223611	.0255556	.02875	.0319444	.0351389	.0383333
3	26.	.0161111	.0193333	.0225556	.0257778	.029	.0322222	.0354444	.0386667
3	27.	.01625	.0195	.02275	.026	.02925	.0325	.03575	.039
3	28.	.0163889	.0196667	.0229444	.0262222	.0295	.0327778	.0360556	.0393333
3	29.	.0165278	.0198333	.0231389	.0264444	.02975	.0330556	.0363611	.0396667
4	...	.0166667	.02	.0233333	.0266667	.03	.0333333	.0366667	.04
4	1.	.0168056	.0201667	.0235278	.0268889	.03025	.0336111	.0369722	.0403333
4	2.	.0169444	0203333	.0237222	.0271111	.0305	.0338889	.0372778	.0406667
4	3.	.0170833	.0205	.0239167	.0273333	.03075	.0341667	.0375833	.041
4	4.	.0172222	.0206667	.0241111	.0275556	.031	.0344444	.0378889	.0413333
4	5.	.0173611	.0208333	.0243056	.0277778	.03125	.0347222	.0381944	.0416667
4	6.	.0175	.021	.0245	.028	.0315	.035	.0385	.042
4	7.	.0176389	.0211667	.0246944	.0282222	.03175	.0352778	.0388056	.0423333
4	8.	.0177778	.0213333	.0248889	.0284444	.032	.0355556	.0391111	.0426667
4	9.	.0179167	.0215	.0250833	.0286667	.03225	.0358333	.0394167	.043
4	10.	.0180556	.0216667	.0252778	.0288889	.0325	.0361111	.0397222	.0433333

INTEREST TABLES—CONTINUED.

TIME. M.	D.	5 % PER YEAR	6 % PER YEAR	7 % PER YEAR	8 % PER YEAR	9 % PER YEAR	10 % PER YEAR	11 % PER YEAR	12 % PER YEAR
4	11.	.0181944	.0218333	.0254722	.0291111	.03275	.0363889	.0400278	.0436667
4	12.	.0183333	.022	.0256667	.0293333	.033	.0366667	.0403333	.044
4	13.	.0184722	.0221667	.0258611	.0295556	.03325	.0369444	.0406389	.0443333
4	14.	.0186111	.0223333	.0260556	.0297778	.0335	.0372222	.0409444	.0446667
4	15.	.01875	.0225	.02625	.03	.03375	.0375	.04125	.045
4	16.	.0188889	.0226667	.0264444	.0302222	.034	.0377778	.0415556	.0453333
4	17	.0190278	.0228333	.0266389	.0304444	.03425	.0380556	.0418611	.0456667
4	18.	.0191667	.023	.0268333	.0306667	.0345	.0383333	.0421667	.046
4	19.	.0193056	.0231667	.0270278	.0308889	.03475	.0386111	.0424722	.0463333
4	20.	.0194444	.0233333	.0272222	.0311111	.035	.0388889	.0427778	.0466667
4	21.	.0195833	.0235	.0274167	.0313333	.03525	.0391667	.0430833	.047
4	22.	.0197222	.0236667	.0276111	.0315556	.0355	.0394444	.0433889	.0473333
4	23.	.0198611	.0238333	.0278056	.0317778	.03575	.0397222	.0436944	.0476667
4	24.	.02	.024	.028	.032	.036	.04	.044	.048
4	25.	.0201389	.0241667	.0281944	.0322222	.03625	.0402778	.0443056	.0483333
4	26.	.0202778	.0243333	.0283889	.0324444	.0365	.0405556	.0446111	.0486667
4	27.	.0204167	.0245	.0285833	.0326667	.03675	.0408333	.0449167	.049
4	28.	.0205556	.0246667	.0287778	.0328889	.037	.0411111	.0452222	.0493333
4	29.	.0206944	.0248333	.0289722	.0331111	.03725	.0413889	.0455278	.0496667
5	...	.0208333	.025	.0291667	.0333333	.0375	.0416667	.0458333	.05
5	1.	.0209722	.0251667	.0293611	.0335556	.03775	.0419444	.0461389	.0503333
5	2	.0211111	.0253333	.0295556	.0337778	.038	.0422222	.0464444	.0506667
5	3.	.02125	.0255	.02975	.034	.03825	.0425	.04675	.051
5	4.	.0213889	.0256667	.0299444	.0342222	.0385	.0427778	.0470556	.0513333
5	5.	0215278	.0258333	.0301389	.0344444	.03875	.0430556	.0473611	.0516667
5	6.	.0216667	.026	.0303333	.0346667	.039	.0433333	.0476667	.052
5	7.	.0218056	.0261667	.0305278	.0348889	.03925	.0436111	.0479722	.0523333
5	8.	.0219444	.0263333	.0307222	.0351111	.0395	.0438889	.0482778	.0526667
5	9.	.0220833	.0265	.0309167	.0353333	.03975	.0441667	0485833	.053
5	10.	.0222222	.0266667	.0311111	.0355556	.04	.0444444	.0488889	.0533333
5	11.	.0223611	.0268333	.0313056	.0357778	.04025	.0447222	.0491944	.0536667
5	12.	.0225	.027	.0315	.036	.0405	.045	.0495	.054
5	13.	.0226389	.0271667	.0316944	.0362222	.04075	.0452778	.0498056	.0543333
5	14.	.0227778	.0273333	.0318889	.0364444	.041	.0455556	.0501111	.0546667
5	15.	.0229167	.0275	.0320833	.0366667	.04125	.0458333	.0504167	.055
5	16.	.0230556	.0276667	.0322778	.0368889	.0415	.0461111	.0507222	.0553333
5	17.	.0231944	.0278333	.0324722	.0371111	.04175	.0463889	.0510278	.0556667
5	18.	.0233333	.028	.0326667	.0373333	.042	.0466667	.0513333	.056
5	19.	.0234722	.0281667	.0328611	.0375556	.04225	.0469444	.0516389	.0563333
5	20.	.0236111	.0283333	.0330556	.0377778	.0425	.0472222	.0519444	.0566667
5	21.	.02375	.0285	.03325	.038	.04275	.0475	.05225	.057
5	22.	.0238889	.0286667	.0334444	.0382222	.043	.0477778	.0525556	.0573333
5	23.	.0240278	.0288333	.0336389	.0384444	.04325	.0480556	.0528611	.0576667
5	24.	.0241667	.029	.0338333	.0386667	.0435	.0483333	.0531667	.058
5	25.	.0243056	.0291667	.0340278	.0388889	.04375	.0486111	.0534722	.0583333
5	26.	.0244444	.0293333	.0342222	.0391111	.044	.0488889	.0537778	.0586667
5	27.	.0245833	.0295	.0344167	.0393333	.04425	.0491667	.0540833	.059
5	28.	.0247222	.0296667	.0346111	.0395556	.0445	.0494444	.0543889	.0593333
5	29.	.0248611	.0298333	.0348056	.0397778	.04475	.0497222	.0546944	.0596667
6	...	.025	.03	.035	.04	.045	.05	.055	.06
6	1.	.0251389	.0301667	.0351944	.0402222	.04525	.0502778	.0553056	.0603333
6	2.	.0252778	.0303333	.0353889	.0404444	.0455	.0505556	.0556111	.0606667
6	3.	.0254167	.0305	.0355833	.0406667	.04575	.0508333	.0559167	.061
6	4.	.0255556	.0306667	.0357778	.0408889	.046	.0511111	.0562222	.0613333
6	5.	.0256944	.0308333	.0359722	.0411111	.04625	.0513889	.0565278	.0616667
6	6	.0258333	.031	.0361667	.0413333	.0465	.0516667	.0568333	.062
6	7.	.0259722	.0311667	.0363611	.0415556	.04675	.0519444	.0571389	.0623333
6	8.	.0261111	.0313333	.0365556	.0417778	.047	.0522222	.0574444	.0626667
6	9.	.02625	.0315	.03675	.042	.04725	.0525	.05775	.063
6	10.	.0263889	.0316667	.0369444	.0422222	.0475	.0527778	.0580556	.0633333
6	11.	.0265278	.0318333	.0371389	.0424444	.04775	.0530556	.0583611	.0636667
6	12.	.0266667	.032	.0373333	.0426667	.048	.0533333	.0586667	.064
6	13.	.0268056	.0321667	.0375278	.0428889	.04825	.0536111	.0589722	.0643333
6	14.	.0269444	.0323333	.0377222	.0431111	.0485	.0538889	.0592778	.0646667
6	15.	.0270833	.0325	.0379167	.0433333	.04875	.0541667	.0595833	.065
6	16.	.0272222	.0326667	.0381111	.0435556	.049	.0544444	.0598889	.0653333

INTEREST TABLES—CONTINUED.

TIME. M.	D.	5 % PER YEAR	6 % PER YEAR	7 % PER YEAR	8 % PER YEAR	9 % PER YEAR	10 % PER YEAR	11 % PER YEAR	12 % PER YEAR
6	17.	.0273611	.0328333	.0383056	.0437778	.04925	.0547222	.0601944	.0656667
6	18.	.0275	.033	.0385	.044	.0495	.055	.0605	.066
6	19.	.0276389	.0331667	.0386944	.0442222	.04975	.0552778	.0608056	.0663333
6	20	.0277778	.0333333	.0388889	.0444444	.05	.0555556	.0611111	.0666667
6	21.	.0279167	.0335	.0390833	.0446667	.05025	.0558333	.0614167	.067
6	22.	.0280556	.0336667	.0392778	.0448889	.0505	.0561111	.0617222	.0673333
6	23.	.0281944	.0338333	.0394722	.0451111	.05075	.0563889	.0620278	.0676667
6	24.	.0283333	.034	.0396667	.0453333	.051	.0566667	.0623333	.068
6	25.	.0284722	.0341667	.0398611	.0455556	.05125	.0569444	.0626389	.0683333
6	26.	.0286111	.0343333	.0400556	.0457778	.0515	.0572222	.0629444	.0686667
6	27.	.02875	.0345	.04025	.046	.05175	.0575	.06325	.069
6	28.	.0288889	.0346667	.0404444	.0462222	.052	.0577778	.0635556	.0693333
6	29.	.0290278	.0348333	.0406389	.0464444	.05225	.0580556	.0638611	.0696667
7	...	.0291667	.035	.0408333	.0466667	.0525	.0583333	.0641667	.07
7	1.	.0293056	.0351667	.0410278	.0468889	.05275	.0586111	.0644722	.0703333
7	2.	.0294444	.0353333	.0412222	.0471111	.053	.0588889	.0647778	.0706667
7	3.	.0295833	.0355	.0414167	.0473333	.05325	.0591667	.0650833	.071
7	4.	.0297222	.0356667	.0416111	.0475556	.0535	.0594444	.0653889	.0713333
7	5	.0298611	.0358333	.0418056	.0477778	.05375	.0597222	.0656944	.0716667
7	6.	.03	.036	.042	.048	.054	.06	.066	.072
7	7.	.0301389	.0361667	.0421944	.0482222	.05425	.0602778	.0663056	.0723333
7	8.	.0302778	.0363333	.0423889	.0484444	.0545	.0605556	.0666111	.0726667
7	9	.0304167	.0365	.0425833	.0486667	.05475	.0608333	.0669167	.073
7	10.	.0305556	.0366667	.0427778	.0488889	.055	.0611111	.0672222	.0733333
7	11.	.0306944	.0368333	.0429722	.0491111	.05525	.0613889	.0675278	.0736667
7	12.	.0308333	.037	.0431667	.0493333	.0555	.0616667	.0678333	.074
7	13.	.0309722	.0371667	.0433611	.0495556	.05575	.0619444	.0681389	.0743333
7	14.	.0311111	.0373333	.0435556	.0497778	.056	.0622222	.0684444	.0746667
7	15.	.03125	.0375	.04375	.05	.05625	.0625	.06875	.075
7	16.	.0313889	0376667	.0439444	.0502222	.0565	.0627778	.0690556	.0753333
7	17.	.0315278	.0378333	.0441389	.0504444	.05675	.0630556	.0693611	.0756667
7	18.	.0316667	.038	.0443333	.0506667	.057	.0633333	.0696667	.076
7	19.	0318056	.0381667	.0445278	.0508889	.05725	.0636111	.0699722	.0763333
7	20.	.0319444	.0383333	.0447222	.0511111	.0575	.0638889	.0702778	.0766667
7	21.	.0320833	.0385	.0449167	.0513333	.05775	.0641667	.0705833	.077
7	22.	.0322222	.0386667	.0451111	.0515556	.058	.0644444	.0708889	.0773333
7	23.	.0323611	0388333	.0453056	.0517778	.05825	.0647222	.0711944	.0776667
7	24.	.0325	.039	.0455	.052	.0585	.065	.0715	.078
7	25.	.0326389	.0391667	.0456944	.0522222	.05875	.0652778	.0718056	.0783333
7	26.	.0327778	.0393333	.0458889	.0524444	.059	.0655556	.0721111	.0786667
7	27.	.0329167	.0395	.0460833	.0526667	.05925	.0658333	.0724167	.079
7	28.	.0330556	.0396667	.0462778	.0528889	.0595	.0661111	.0727222	.0793333
7	29.	.0331944	.0398333	.0464722	.0531111	.05975	.0663889	.0730278	.0796667
8	...	.0333333	.04	.0466667	.0533333	.06	.0666667	.0733333	.08
8	1.	.0334722	.0401667	.0468611	.0535556	.06025	.0669444	.0736389	.0803333
8	2.	.0336111	.0403333	.0470556	.0537778	.0605	.0672222	.0739444	.0806667
8	3.	.03375	.0405	.04725	.054	.06075	.0675	.07425	.081
8	4.	.0338889	.0406667	.0474444	.0542222	.061	.0677778	.0745556	.0813333
8	5.	.0340278	.0408333	.0476389	.0544444	.06125	.0680556	.0748611	.0816667
8	6.	.0341667	.041	.0478333	.0546667	.0615	.0683333	.0751667	.082
8	7.	.0343056	.0411667	.0480278	.0548889	.06175	.0686111	.0754722	.0823333
8	8.	.0344444	.0413333	.0482222	.0551111	.062	.0688889	.0757778	.0826667
8	9.	.0345833	.0415	.0484167	.0553333	.06225	.0691667	.0760833	.083
8	10.	.0347222	.0416667	.0486111	.0555556	.0625	.0694444	.0763889	.0833333
8	11.	.0348611	.0418333	.0488056	.0557778	.06275	.0697222	.0766944	.0836667
8	12.	.035	.042	.049	.056	.063	.07	.077	.084
8	13.	.0351389	.0421667	.0491944	.0562222	.06325	.0702778	.0773056	.0843333
8	14.	.0352778	.0423333	.0493889	.0564444	.0635	.0705556	.0776111	.0846667
8	15.	.0354167	.0425	.0495833	.0566667	.06375	.0708333	.0779167	.085
8	16.	.0355556	.0426667	.0497778	.0568889	.064	.0711111	.0782222	.0853333
8	17.	.0356944	.0428333	.0499722	.0571111	.06425	.0713889	.0785278	.0856667
8	18.	.0358333	.043	.0501667	.0573333	.0645	.0716667	.0788333	.086
8	19.	.0359722	.0431667	.0503611	.0575556	.06475	.0719444	.0791389	.0863333
8	20.	.0361111	.0433333	.0505556	.0577778	.065	.0722222	.0794444	.0866667
8	21.	.03625	.0435	.05075	.058	.06525	.0725	.07975	.087
8	22.	.0363889	.0436667	.0509444	.0582222	.0655	.0727778	.0800556	.0873333

INTEREST TABLES—CONTINUED.

TIME. M. D.	5 % PER YEAR	6 % PER YEAR	7 % PER YEAR	8 % PER YEAR	9 % PER YEAR	10 % PER YEAR	11 % PER YEAR	12 % PER YEAR
8 23.	.0365278	.0438333	.0511389	.0584444	.06575	.0730556	.0803611	.0876667
8 24.	.0366667	.044	.0513333	.0586667	.066	.0733333	.0806667	.088
8 25.	.0368056	.0441667	.0515278	.0588889	.06625	.0736111	.0809722	.0883333
8 26.	.0369444	.0443333	0517222	0591111	.0665	.0738889	.0812778	.0886667
8 27.	.0370833	.0445	.0519167	.0593333	.06675	.0741667	.0815833	.089
8 28.	.0372222	.0446667	.0521111	.0595556	.067	.0744444	.0818889	.0893333
8 29.	.0373611	.0448333	.0523056	.0597778	.06725	.0747222	.0821944	.0896667
9 ...	.0375	.045	.0525	.06	.0675	.075	.0825	.09
9 1.	.0376389	.0451667	0526944	.0602222	.06775	.0752778	.0828056	.0903333
9 2.	.0377778	.0453333	.0528889	.0604444	.068	.0755556	.0831111	.0906667
9 3.	.0379167	.0455	.0530833	.0606667	.06825	.0758333	.0834167	.091
9 4.	.0380556	.0456667	.0532778	.0608889	.0685	.0761111	.0837222	.0913333
9 5.	.0381944	.0458333	.0534722	.0611111	.06875	.0763889	.0840278	.0916667
9 6.	.0383333	.046	.0536667	.0613333	.069	.0766667	.0843333	.092
9 7.	.0384722	.0461667	.0538611	.0615556	.06925	.0769444	.0846389	.0923333
9 8.	.0386111	.0463333	.0540556	.0617778	.0695	.0772222	.0849444	.0926667
9 9.	.03875	.0465	.05425	.062	.06975	.0775	.08525	.093
9 10.	.0388889	.0466667	.0544444	.0622222	07	.0777778	.0855556	.0933333
9 11.	.0390278	.0468333	.0546389	.0624444	07025	.0780056	.0858611	.0936667
9 12.	.0391667	.047	.0548333	.0626667	.0705	.0783333	.0861667	.094
9 13.	.0393056	.0471667	.0550278	.0628889	.07075	.0786111	.0864722	.0943333
9 14.	.0394444	.0473333	.0552222	.0631111	.071	.0788889	.0867778	.0946667
9 15.	.0395833	.0475	.0554167	.0633333	.07125	.0791667	.0870833	.095
9 16.	.0397222	.0476667	.0556111	.0635556	.0715	.0794444	.0873889	.0953333
9 17.	.0398611	.0478333	.0558056	.0637778	.07175	.0797222	.0876944	.0956667
9 18.	.04	.048	.056	.064	.072	.08	.088	.096
9 19.	0401389	.0481667	.0561944	.0642222	.07225	0802778	.0883056	.0963333
9 20.	0402778	.0483333	.0563889	.0644444	.0725	.0805556	.0886111	.0966667
9 21.	0404167	.0485	.0565833	.0646667	.07275	.0808333	.0889167	.097
9 22.	.0405556	.0486667	.0567778	.0648889	.073	.0811111	.0892222	.0973333
9 23.	.0406944	.0488333	.0569722	.0651111	.07325	.0813889	.0895278	.0976667
9 24.	0408333	049	.0571667	.0653333	.0735	.0816667	.0898333	.098
9 25.	.0409722	.0491667	.0573611	.0655556	.07375	.0819444	.0901389	.0983333
9 26.	.0411111	.0493333	.0575556	.0657778	.074	.0822222	.0904444	.0986667
9 27.	.04125	.0495	.05775	.066	.07425	.0825	.09075	.099
9 28.	.0413889	0496667	.0579444	.0662222	.0745	.0827778	.0910556	.0993333
9 29.	.0415278	.0498333	.0581389	.0664444	.07475	.0830556	.0913611	.0996667
10 ...	.0416667	05	.0583333	.0666667	.075	.0833333	.0916667	.10
10 1.	.0418056	0501667	.0585278	.0668889	.07525	.0836111	.0919722	.1003333
10 2.	.0419444	0503333	.0587222	.0671111	.0755	.0838889	.0922778	.1006667
10 3.	.0420833	0505	0589167	.0673333	.07575	.0841667	.0925833	.101
10 4.	.0422222	0506667	.0591111	.0675556	.076	.0844444	.0928889	.1013333
10 5.	.0423611	0508333	.0593056	.0677778	.07625	.0847222	.0931944	.1016667
10 6.	.0425	.051	.0595	.068	.0765	.085	.0935	.102
10 7.	.0426389	.0511667	.0596944	.0682222	.07675	.0852778	.0938056	.1023333
10 8.	.0427778	.0513333	.0598889	.0684444	.077	.0855556	.0941111	.1026667
10 9.	.0429167	.0515	.0600833	.0686667	.07725	.0858333	.0944167	.103
10 10.	.0430556	.0516667	.0602778	.0688889	.0775	.0861111	.0947222	.1033333
10 11.	.0431944	.0518333	.0604722	.0691111	.07775	.0863889	.0950278	.1036667
10 12.	.0433333	.052	.0606667	.0693333	.078	.0866667	.0953333	.104
10 13.	.0434722	.0521667	.0608611	.0695556	.07825	.0869444	.0956389	.1043333
10 14.	.0436111	.0523333	.0610556	.0697778	.0785	.0872222	.0959444	.1046667
10 15.	.04375	.0525	.06125	.07	.07875	.0875	.09625	.105
10 16.	.0438889	.0526667	.0614444	.0702222	.079	.0877778	.0965556	.1053333
10 17.	.0440278	.0528333	.0616389	.0704444	.07925	.0880556	.0968611	.1056667
10 18.	.0441667	.053	.0618333	.0706667	.0795	.0883333	.0971667	.106
10 19.	.0443056	.0531667	.0620278	.0708889	.07975	.0886111	.0974722	.1063333
10 20.	.0444444	.0533333	.0622222	.0711111	.08	.0888889	.0977778	.1066667
10 21.	.0445833	.0535	.0624167	.0713333	.08025	.0891667	.0980833	.107
10 22.	.0447222	0536667	.0626111	.0715556	.0805	.0894444	.0983889	1073333
10 23.	.0448611	.0538333	.0628056	.0717778	.08075	.0897222	.0986944	.1076667
10 24.	.045	.054	.063	.072	.081	.09	.099	.108
10 25.	.0451389	.0541667	.0631944	.0722222	.08125	.0902778	.0993056	.1083333
10 26.	.0452778	.0543333	.0633889	.0724444	.0815	.0905556	.0996111	.1086667
10 27.	.0454167	.0545	.0635833	.0726667	.08175	.0908333	.0999167	.109
10 28.	.0455556	.0546667	.0637778	.0728889	.082	.0911111	.1002222	.1093333

INTEREST TABLES—CONTINUED.

TIME. M. D.	5 % PER YEAR	6 % PER YEAR	7 % PER YEAR	8 % PER YEAR	9 % PER YEAR	10 % PER YEAR	11 % PER YEAR	12 % PER YEAR
10 29.	.0456944	.0548333	.0639722	.0731111	.08225	.0913889	.1005278	.1096667
11 ...	.0458333	.055	.0641667	.0733333	.0825	.0916667	.1008333	.11
11 1.	.0459722	.0551667	.0643611	.0735556	.08275	.0919444	.1011389	.1103333
11 2.	.0461111	.0553333	.0645556	.0737778	.083	.0922222	.1014444	.1106667
11 3.	.04625	.0555	.06475	.074	.08325	.0925	.10175	.111
11 4.	.0463889	.0556667	.0649444	.0742222	.0835	.0927778	.1020556	.1113333
11 5.	.0465278	.0558333	.0651389	.0744444	.08375	.0930556	.1023611	.1116667
11 6.	.0466667	.056	.0653333	.0746667	.084	.0933333	.1026667	.112
11 7.	.0468056	.0561667	.0655278	.0748889	.08425	.0936111	.1029722	.1123333
11 8.	.0469444	.0563333	.0657222	.0751111	.0845	.0938889	.1032778	.1126667
11 9.	.0470833	.0565	.0659167	.0753333	.08475	.0941667	.1035833	.113
11 10.	.0472222	.0566667	.0661111	.0755556	.085	.0944444	.1038889	.1133333
11 11.	.0473611	.0568333	.0663056	.0757778	.08525	.0947222	.1041944	.1136667
11 12.	.0475	.057	.0665	.076	.0855	.095	.1045	.114
11 13.	.0476389	.0571667	.0666944	.0762222	.08575	.0952778	.1048056	.1143333
11 14.	.0477778	.0573333	.0668889	.0764444	.086	.0955556	.1051111	.1146667
11 15.	.0479167	.0575	.0670833	.0766667	.08625	.0958333	.1054167	.115
11 16.	.0480556	.0576667	.0672778	.0768889	.0865	.0961111	.1057222	.1153336
11 17.	.0481944	.0578333	.0674722	.0771111	.08675	.0963889	.1060278	.1156667
11 18.	.0483333	.058	.0676667	.0773333	.087	.0966667	.1063333	.116
11 19.	.0484722	.0581667	.0678611	.0775556	.08725	.0969444	.1066389	.1163333
11 20.	.0486111	.0583333	.0680556	.0777778	.0875	.0972222	.1069444	.1166667
11 21.	.04875	.0585	.06825	.078	.08775	.0975	.10725	.117
11 22.	.0488889	.0586667	.0684444	.0782222	.088	.0977778	.1075556	.1173333
11 23.	.0490278	.0588333	.0686389	.0784444	.08825	.0980556	.1078611	.1176667
11 24.	.0491667	.059	.0688333	.0786667	.0885	.0983333	.1081667	.118
11 25.	.0493056	.0591667	.0690278	.0788889	.08875	.0986111	.1084722	.1183333
11 26.	.0494444	.0593333	.0692222	.0791111	.089	.0988889	.1087778	.1186667
11 27.	.0495833	.0595	.0694167	.0793333	.08925	.0991667	.1090883	.119
11 28.	.0497222	.0596667	.0696111	.0795555	.0895	.0994444	.1093889	.1193333
11 29.	.0498611	.0598333	.0698056	.0797778	.08975	.0997222	.1096944	.1196667
12 ...	.05	.06	.07	.08	.09	.10	.11	.12
1 y'r.	.05	.06	.07	.08	.09	.10	.11	.12
2 " .	.10	.12	.14	.16	.18	.20	.22	.24
3 " .	.15	.18	.21	.24	.27	.30	.33	.36
4 " .	.20	.24	.28	.32	.36	.40	.44	.48
5 " .	.25	.30	.35	.40	.45	.50	.55	.60
6 " .	.30	.36	.42	.48	.54	.60	.66	.72
7 " .	.35	.42	.49	.56	.63	.70	.77	.84
8 " .	.40	.48	.56	.64	.72	.80	.88	.96
9 " .	.45	.54	.63	.72	.81	.90	.99	1.08
10 " .	.50	.60	.70	.80	.90	1.00	1.10	1.20
11 " .	.55	.66	.77	.88	.99	1.10	1.21	1.32
12 " .	.60	.72	.84	.96	1.08	1.20	1.32	1.44
13 " .	.65	.78	.91	1.04	1.17	1.30	1.43	1.56
14 " .	.70	.84	.98	1.12	1.26	1.40	1.54	1.68
15 " .	.75	.90	1.05	1.20	1.35	1.50	1.65	1.80
16 " .	.80	.96	1.12	1.28	1.44	1.60	1.76	1.92
17 " .	.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
18 " .	.90	1.08	1.26	1.44	1.62	1.80	1.98	2.16
19 " .	.95	1.14	1.33	1.52	1.71	1.90	2.09	2.28
20 " .	1.00	1.20	1.40	1.60	1.80	2.00	2.10	2.40

1. EXAMPLE—What is the interest on $15,000 for 10 months and 29 days at 7 %

Interest on one dollar for given time........................$ .0639722
Multiply by the principal.................................. 15000

The interest required is.................................. $959.58

2. EXAMPLE—What is the interest on $12,643.57 for 3 years, 11 months and 8 days at 8 %

Interest on one dollar for 3 years..........................$.24
" " " " 11 months and 8 days.... .... .0751111

" " " " 3 years, 11 months and 8 days....$.3151111
Multiply by the principal.................................. 12643.57

The interest required is....................................$3984.13

COMPOUND INTEREST—Continued.

Table showing the accumulation of principal and interest on **one dollar**, compounded semi-annually; interest from three to ten per cent., from one to fifty years.

No. of Years.	3 per cent.	4 per cent.	4½ per cent.	5 per cent.	6 per cent.	7 per cent.	7 3-10 pr cent.	8 per cent.	10 per cent.
1....	$1.0302	$1.0404	$1.0455	$1.0506	$1.0609	$1.0712	$1.0743	$1.0816	$1.1025
2....	1.0613	1.0824	1.0930	1.1028	1.1255	1.1475	1.1530	1.1692	1.2155
3....	1.0934	1.1261	1.1438	1.1596	1.1940	1.2292	1.2387	1.2646	1.3400
4....	1.1264	1.1715	1.1948	1.2184	1.2667	1.3168	1·3308	1.3678	1.4773
5....	1.1605	1.2188	1.2481	1.2800	1.3439	1.4105	1.4298	1.4794	1.6287
6....	1.1956	1.2681	1.3004	1.3448	1.4257	1.5110	1.5360	1.6002	1.7957
7....	1.2317	1.3193	1.3643	1.4129	1.5125	1.6186	1.6502	1.7307	1.9747
8 ..	1.2689	1.3726	1.4264	1.4845	1.6047	1.7339	1.7729	1 8720	2.1827
9....	1.3073	1.4281	1.4913	1.5596	1.7024	1.8574	1.9047	2.0247	2.4064
10....	1.3463	1.4858	1.5592	1.6385	1.8061	1.9897	2.0462	2.1899	2.6530
11....	1.3875	1.5458	1.6301	1 7234	1.9161	2.1315	2.1982	2.3687	2.9250
12....	1.4295	1.6082	1.7044	1.8086	2.0326	2.2833	2.3617	2.5619	3.2248
13....	1.4727	1.6732	1.7820	1.9001	2.1564	2.4459	2.5372	2.7710	3 5558
14....	1.5172	1.7408	1.8631	1.9963	2.2878	2.6201	2.7258	2.9971	3.9198
15....	1.5630	1.8111	1.9479	2.0933	2.4271	2.8068	2.9284	3.2417	4.3216
16....	1.6103	1.8843	2.0365	2.2027	2.5749	3.0067	3.1461	3.5062	4.7645
17....	1.6589	1.9604	2 1272	2.3142	2.7317	3.2208	3.3800	3.7923	5.2529
18....	1.7091	2.0396	2.2240	2 4313	2.8981	3.4502	3.6312	4.1018	5.7883
19....	1.7607	2.1220	2·3252	2.5544	3 0746	3.6960	3.9011	4.4365	6.3816
20....	1.8140	2,2078	2 4310	2.6837	3.2618	3.9592	4.1911	4.7985	7.0362
21....	1.8686	2.2970	2.5415	2.8196	3.4605	4.2412	4.5026	5.1900	7.7574
22....	1.9253	2.3898	2.6572	2.9624	3.6712	4.5433	4.8373	5.6136	8.5525
23....	1.9835	2.4863	2.7781	3.1123	3.8948	4.8669	5.1969	6.0716	9.4292
24....	2.0434	2.5868	2.9045	3.2699	4.1320	5.2136	5.5832	6.5670	10.3957
25....	2.1052	2.6913	3 0367	3.4354	4.3836	5.5849	5.9982	7.1030	11.4612
26....	2.1688	2.8006	3.1749	3.6094	4.6506	5.9827	6.4441	7.6826	12.6359
27....	2.2344	2.9131	3.3193	3.7921	4.9338	6.4088	6.9231	8.3094	13.9311
28....	2.3019	3.0318	3.4703	3.9841	5.2343	6.8653	7.4377	8.9875	15.3591
29....	2.3715	3.1543	3.6282	4.1858	5.5531	7.3543	7.9906	9.7208	16.9334
30. ..	2.4432	3.2818	3.7933	4.3977	5.8913	7.8781	8.5846	10.5143	18.6691
31....	2.5170	3.4144	3.9660	4.6203	6.2500	8.4391	9.2227	11.3742	20.5827
32....	2.5931	3.5523	4.1465	4.8542	6.6307	9.0402	9.9087	12.3024	22.6924
33....	2.6715	3.6958	4.3351	5.0999	7.0345	9.6841	10.6453	13.3062	25.0184
34....	2.7522	3.8451	4.5324	5.3581	7.4629	10.3738	11.4366	14.3920	27.5828
35....	2.8354	4.0005	4.7387	5.6294	7.9174	11.1126	12.2867	15.5664	30.4081
36....	2.9211	4.1621	4.9543	5.9144	8.3996	11.9041	13.2000	16.8367	33.5249
37....	3.0094	4.3302	5.1798	6.2138	8.9111	12.7620	14.1811	18.2105	36.9612
38....	3.1004	4.5052	5.4146	6.5284	9.4538	13.6709	15.2353	19.6965	40.7497
39....	3.1941	4.6872	5.6610	6.8589	10.0295	14.6446	16.3677	21.3038	44.9266
40....	3.2907	4.8766	5.9288	7.2061	10.6403	15.6877	17.5844	23.0422	49.5316
41...	3.3901	5.0736	6.1986	7.5709	11.2883	16.8050	18.8915	24.9224	54.6086
42....	3.4926	5.2785	6.4807	7.9542	11.9758	18 0020	20.2956	26.9561	60.2059
43....	3.5982	5.4928	6.7756	8.3569	12.7051	19.2842	21.8043	29.1857	66.3771
44....	3.7070	5.7147	7.0840	8.7800	13.8832	20.6577	23.2350	31.5348	73.1807
45....	3.8191	5.9456	7.4062	9.2245	14.7287	22.1290	25.1663	34.1080	80.6817
46....	3 9345	6.1858	7.7430	9.6915	15.6257	23.7052	27.0369	36.8813	88.9516
47....	4.0432	6.4357	8.0954	10.1822	16.5773	25.3936	29.0466	39.8908	98.0692
48....	4 1655	6.6957	8.4638	10.6967	17.5868	27.2022	31.2057	43.1459	107.1213
49....	4.2914	6.9662	8.8490	11.2383	18.6597	29.1397	33.5253	46.6666	118.1012
50....	4.4211	7.2477	9.2516	11.8072	19.7941	31 2141	36.0154	50.4746	130 2066

HEIGHT OF COLUMNS, TOWERS, DOMES, SPIRES, ETC.

Name.	Location.	Feet.	Name.	Location.	Feet.
Washington	Washington	555	Cathedral	Cremona	392
Chimney, St. Rollox	Glasgow	455½	Cathedral	Florence	384
Chimney, Musprat's	Liverpool	406	St. Paul's	London	366
Bunker Hill	Mass.	221⅛	St. Paul's (D. Dome)	London	112
City	London	202	Cathedral	St. Petersburg.	363
Alexander	St. Petersburg.	175	St. Marks	Venice	328
Nelson's	London	171	Capitol	Wash., U. S.	287½
July	Paris	157	" (Diam. Dome)	Wash., U. S.	124¾
Trajan	Rome	145	Cathedral	Escurial	200
York	London	138	Porcelain	China	200
Place Vendome	Paris	136	Leaning	Pisa	188
Nelson's	Dublin	134	Nicolai Church	Hamburg, Ger.	482.3
Napoleon	Paris	132	St. Stephen's	Vienna	465
Pompey's Pillar	Egypt	114	Salisbury	Salisb'y, Eng.	450
Eiffel Tower	Paris, France	984	St. Mary's	Lubeck	404
Babel		680	Cathedral	New York.	325
City Hall	Phila., Pa.	537⅓	Trinity Church	New York.	286
Cathedral	Cologne	501	Grace Church	New York.	216
Cathedral	Rouen	492	St. John's	New York.	210
Cathedral	Antwerp	476	St. Paul's	New York	200
Cathedral	Strasbourg	486	Pyramid Jeezeh	Egypt	486½
Utrecht		464	Pyramid of Sakkara	Egypt	356
St. Peter's	Rome	457	Hotel des Invalides.	Paris	344
" (Diam. Dome)	Rome	195½	Balus. Notre Dame	Paris	216
Cathedral	Milan	438			

CASCADES AND WATERFALLS.

Name.	Location.	Feet.	Name.	Location.	Feet.
Sentinel	Yosemite V.	3270			50
Yosemite	"	2634	Missouri	Montana	80
Royal Arch	"	2000			94
Cascade	Alps	2400	Passaic	NewJersey	74
Arve	Savoy	1600	Potomac	Va. & Md.	74
Montmorency	Canada	250	Mohawk	New York	68
Niagara	N. America	164	Cataracts of Nile	Egypt	40

*ALTITUDES OF YOSEMITE VALLEY—WATERFALLS.

Indian Name.	Signification.	American Name.	Height.
Pohono	Spirit of the Evil Wind	Bridal Veil	940 ft.
Yosemite	Large Grizzly Bear	†	2634 ft.
Pi-wy-ack	Cataract of Diamonds	Vernal	400 ft.
Yo-wi-ye	Meandering	Nevada	600 ft.
Too-lool-we-ack		South Fork	600 ft.
Loya	A Medicinal Shrub	Sentinel	3270 ft.
To-co-yæ	Shade to Baby Cradle Basket.	Royal Arch Fall	2000 ft.

† First Fall, 1600 feet; Second Fall, 534 feet; Third Fall, 500 feet.

*MOUNTAINS.

Tis-sa-ack	Goddess of the Valley	Half Dome	5300 ft.
		Cloud's Rest	5700 ft.
To-co-yæ	Shade to Baby Cradle Basket.	North Dome	3568 ft.
Hunto	Watching Eye	Washingt'n Tower	2200 ft.
Mah-ta	Martyr or Suicide Mountain.	Cap of Liberty	4600 ft.
See-wah-lam		Mt. Star King.	5600 ft.
Er-na-ting Law-oo-too	Bearskin Mountain	Glacier Rock	3700 ft.
Loya	A Medicinal Shrub	Sentinel	3043 ft.
Poo-see-nah Chuck-ka	Large Acorn Store House	Cathedral Rock	2660 ft.
Wah-wah-le-na		Three Graces	3750 ft.
		Inspiration Point.	2850 ft.
Pom-pom-pa-sus	Mountains Playing Leap Frog	Three Brothers	4200 ft.
Tu-toch-ah-nu-lah	Great Chief of the Valley	El Capitan	3300 ft.

The Yosemite Valley is a little over seven miles in length and from half a mile to one mile in width. It is 4060 feet above the level of the sea.

* Altitudes are reckoned above the floor of the valley.

TIME OF DIFFERENT LOCALITIES.

EXPLANATORY.—When it is 12 o'clock at noon in San Francisco, the time at other places is as denoted in the table. In the Latitude of San Francisco a difference of one minute in time is equivalent to about 13.64 statute miles in distance.

LOCALITIES.	TIME. H.	M	S.		LOCALITIES.	TIME. H.	M	S.	
Albany, N. Y.	3	14	41	P. M	Louisville, Ky.	2	26	59	P. M
Alexandria, Egypt	10	9	5	P. M	Lyons, France	8	28	57	P. M
Algiers, Algeria	8	21	57	P. M	Madison, Wis	2	12	8	P. M
Amsterdam, Netherlands.	8	29	12	P. M	Madrid, Spain	7	54	54	P. M
Athens, Greece	9	44	34	P. M	Marseilles, France	8	31	8	P. M
Baltimore, Md	3	3	13	P. M	Melbourne, Australia	5	49	35	A. M
Batavia, Java	3	16	52	A. M	Memphis, Tenn	2	9	39	P. M
Berlin, Prussia	9	3	14	P. M	Mexico, Mexico	1	32	38	P. M
Bern, Switz	8	39	25	P. M	Milan, Italy..	8	46	25	P. M
Boston, Mass	3	25	23	P. M	Mobile, Ala	2	17	32	P. M
Breslau, Prussia	9	17	49	P. M	Montreal, Canada	3	15	27	P. M
Brussels, Belgium	8	27	8	P. M	Moscow, Russia	10	39	56	P. M
Cairo, Egypt	10	14	41	P. M	Naples, Italy	9	6	39	P. M
Calcutta, India	2	3	0	A. M	Nashville, Tenn	2	22	23	P. M
Cambridge, Mass	3	25	9	P. M	Natchez, Miss	2	4	00	P. M
Charleston, S. C	2	49	54	P. M	New Haven, Conn	3	17	58	P. M
Chicago, Ill	2	19	43	P. M	New Orleans, La	2	9	35	P. M
Christiania, Norway	8	52	34	P. M	Newport. R. I	3	24	15	P. M
Cincinnati, Ohio	2	31	41	P. M	New York, N. Y	3	13	39	P. M
Columbia, S. C	2	45	32	P. M	Panama, N. G	2	51	39	P. M
Columbus, Ohio	2	37	31	P. M	Paris, France	8	19	0	P. M
Constantinople, Turkey..	10	5	35	P. M	Pekin, China	3	55	34	A. M
Copenhagen, Denmark	8	59	59	P. M	Philadelphia, Penn	3	9	0	P. M
Des Moines, Iowa	1	55	11	P. M	Pittsburgh, Penn	2	49	43	P. M
Detroit, Mich	2	37	27	P. M	Portland, Me	3	28	45	P. M
Dresden, Saxony	9	4	35	P. M	Portland, Or	11	59	42	A M
Dublin, Ireland	7	44	17	P. M	Portsmouth, N. H	3	26	51	P. M
Edinburgh, Scotland	7	56	58	P. M	Quebec, Canada	3	24	51	P. M
Galveston, Texas	1	50	19	P. M	Quito, Ecuador	2	54	38	P. M
Genoa, Italy	8	45	16	P. M	Raleigh, N. C	2	55	7	P. M
Gibralter, Spain	7	48	15	P. M	Richmond, Va	2	59	51	P. M
Greenwich, England	8	9	39	P. M	Rio de Janerio	5	17	4	P. M
Hague, Netherlands	8	26	53	P. M	Rome, Italy	8	59	28	P. M
Hamburg, Germany	8	49	32	P. M	Sacramento, Cal	0	3	47	P. M
Harrisburgh, Penn	3	2	19	P. M	St. Louis, Mo	2	8	36	P. M
Hartford, Conn	3	18	56	P. M	St. Paul, Minn	1	57	20	P. M
Havana, Cuba	2	40	14	P. M	St. Petersburg, Russia	10	10	53	P. M
Hong Kong, China	3	46	16	A. M	Salt Lake City, Utah	0	41	15	P. M
Honolulu, H. I	9	38	18	A. M	Santa Fe, N. M	1	10	8	P. M
Indianapolis, Md	2	25	7	P. M	Savannah, Ga	2	45	18	P. M
Jefferson City, Mo	2	1	7	P. M	Stockholm, Sweden	9	21	58	P. M
Jerusalem, Syria	10	30	32	P. M	Valparaiso, Chili	3	23	11	P. M
Lima, Peru	3	1	9	P. M	Venice, Italy	8	59	5	P. M
Lisbon, Portugal	7	33	5	P. M	Vera Cruz, Mexico	1	45	5	P. M
Little Rock, Ark	2	0	40	P. M	Vienna, Austria	9	15	12	P. M
Liverpool, England	7	57	23	P. M	Washington. D. C	3	1	28	P. M
London, England	8	9	16	P. M	Yokohama, Japan	5	28	17	A. M

LENGTH OF A DEGREE OF LONGITUDE AT EACH DEGREE OF LATITUDE.

Lat.	Miles.	Lat.	Miles.	Lat.	Miles.	Lat.	Miles.	Lat.	Miles.	Lat.	Miles.
1°	59.99	16°	57.68	31°	51.43	46°	41.68	61°	29.09	76°	14.52
2	59.96	17	57.38	32	50.88	47	40.92	62	28.17	77	13.50
3	59.92	18	57.06	33	50.32	48	40.15	63	27.24	78	12.47
4	59.85	19	56.73	34	49.74	49	39.36	64	26.30	79	11.45
5	59.77	20	56.38	35	49.15	50	38.57	65	25.36	80	10.42
6	59.67	21	56.01	36	48.54	51	37.76	66	24.40	81	9.39
7	59.55	22	55.63	37	47.92	52	36.94	67	23.44	82	8.35
8	59.42	23	55.23	38	47.28	53	36.11	68	22.48	83	7.31
9	59.26	24	54.81	39	46.63	54	35.27	69	21.50	84	6.27
10	59.09	25	54.38	40	45.96	55	34.41	70	20.52	85	5.23
11	58.90	26	53.93	41	45.28	56	33.55	71	19.53	86	4.19
12	58.69	27	53.46	42	44.59	57	32.68	72	18.54	87	3.14
13	58.46	28	52.98	43	43.88	58	31.80	73	17.54	88	2.09
14	58.22	29	52.48	44	43.16	59	30.90	74	16.54	89	1.05
15	57.96	30	51.96	45	42.43	60	30.00	75	15.53	90	0.00

Distances, in Miles, by the Shortest Post Route, between the Larger and More Important Places in the United States.

FROM POST OFFICE AT	TO POST OFFICES AT Boston, Mass...	New York, N. Y.......	Philadelphia, Pa.........	WASHINGTON, D. C.........	Chicago, Ill.....	Charleston, S. C.........	Cincinnati, Ohio	St. Louis, Mo...	Omaha, Neb...	San Francisco, Cal.........
Alabama.										
Decatur..................	1,192	975	885	747	570	571	417	409	823	2,614
Mobile....................	1,454	1,237	1,147	1,009	858	640	780	643	1,057	2,569
Montgomery...........	1,274	1,057	967	829	753	458	600	592	1,006	2,597
Arizona.										
Prescott	2,884	2,724	2,647	2,560	1,903	2,313	2,031	1,699	1,557	843
Tucson....................	2,816	2,611	2,521	2,383	1,852	2,077	1,916	1,608	1,506	978
Yuma......................	3,063	2,858	2,768	2,630	2,099	2,324	2,163	1,855	1,753	731
Arkansas.										
Fort Smith.............	1.626	1,463	1,373	1,235	701	1,059	759	418	534	2,224
Helena....................	1,467	1,250	1,160	1,022	608	846	574	338	723	2,388
Hot Springs............	1,584	1,367	1,277	1,139	687	963	672	414	789	2,274
Little Rock	1,515	1,298	1,208	1,070	618	894	603	345	720	2,291
Texarkana.............	1,660	1,443	1,353	1,215	763	1,039	748	490	759	2,146
California.										
Eureka....................	3,679	3,546	3,469	3,409	2,654	3,351	2,880	2,577	2,163	296
Los Angeles...........	3,297	3,107	3,017	2,879	2,316	2,573	2,412	2,104	1,970	482
Needles...................	2,967	2,807	2,730	2,643	1,986	2,559	2,114	1,782	1,640	612
Redding..................	3,427	3,294	3,217	3,157	2,402	3,187	2,628	2,325	1,911	260
Sacramento............	3,293	3,160	3,083	3,023	2,268	3,017	2,494	2,191	1,777	90
San Diego...............	3,377	3,172	3,082	2,944	2,413	2,638	2,477	2,169	2,067	663
San Francisco........	3,383	3,250	3,173	3,113	2,358	3,055	2,584	2,281	1,867	......
Colorado.										
Antonito................	2,258	2,098	2,021	1,934	1,277	1,990	1,405	1,073	847	1,396
Denver....................	2,084	1,930	1,853	1,766	1,059	1,834	1,237	917	568	1,457
Granada..................	1,961	1,801	1,724	1,637	980	1,693	1,108	776	634	1,623
Grand Junction......	2,404	2,244	2,167	2,080	1,401	2,136	1,551	1,219	910	1,180
Pueblo....................	2,099	1,939	1,862	1,775	1,118	1,831	1,246	914	688	1,485
Connecticut.										
Hartford.................	117	112	202	340	950	916	856	1,133	1,441	3,308
New Haven.............	141	76	166	304	976	880	820	1,124	1,459	3,326
New London	108	126	216	354	1,026	930	870	1,174	1,509	3,376
Delaware.										
Dover......................	382	165	75	159	851	735	698	999	1,334	3,201
Newark...................	346	129	39	99	807	675	638	955	1,290	3,157
Wilmington............	334	117	27	111	819	687	650	967	1,302	3,169
Dist. of Colum.										
Washington...	**445**	**228**	**138**	....	**772**	**576**	**553**	**894**	**1,246**	**3,113**
Florida.										
Cedar Keys	1,402	1,185	1,095	957	1,198	395	934	1,053	1,467	3,154
Jacksonville...........	1,294	1,077	987	849	1,090	287	826	945	1,359	3,065
Key West...............	1,785	1,568	1,478	1,340	1,581	778	1,317	1,436	1,850	3,528
Pensacola...............	1,437	1,220	1,130	992	916	535	763	748	1,162	2,695
Tallahassee............	1,384	1,167	1,077	939	1,080	377	832	919	1,333	2,900
Tampa.....................	1,533	1,316	1,226	1,088	1,329	526	1,065	1,184	1,598	3,276
Georgia.										
Atlanta	1,099	882	792	654	739	309	475	608	1,022	2,772
Augusta..................	1,023	806	719	578	910	138	646	779	1,193	2,917
Columbus	1,237	1,020	930	792	848	363	613	687	1,101	2,692
Dalton....................	1,069	852	762	624	639	409	375	508	922	2,776
Macon.....................	1,148	931	841	703	828	263	564	697	1,111	2,792
Savannah...............	1,122	905	815	677	1,020	115	756	889	1,303	2,984
Idaho.										
Boise City...............	2,869	2,736	2,660	2,599	1,845	2,684	2,070	1,767	1,353	1,251
McCammon............	2,584	2,451	2,374	2,314	1,559	2,399	1,785	1,482	1,068	966
Pend d'Oreille........	2,859	2,734	2,657	2,606	1,834	2,822	2,128	2,004	1,649	1,198
Illinois.										
Cairo......................	1,243	1,083	1,006	903	365	797	350	150	564	2,431
Chicago..................	1,025	900	823	772	......	988	294	283	491	2,358

DISTANCES BY SHORTEST POST ROUTE—CONTINUED.

From Post Office at	To Post Offices at: Boston, Mass...	New York, N. Y.......	Philadelphia, Pa.........	Washington, D. C.........	Chicago, Ill....	Charleston, S. C.........	Cincinnati, Ohio	St. Louis, Mo...	Omaha, Neb...	San Francisco, Cal.........
Quincy..................	1,273	1,113	1,036	949	263	1,047	420	130	319	2,171
Rock Island..	1,206	1,081	1,004	947	181	1,094	418	247	322	2,189
Springfield..............	1,160	1,000	923	836	185	952	307	98	422	2,274
Indiana.										
Evansville..............	1,137	977	900	797	293	755	244	162	576	2,443
Fort Wayne............	872	751	674	623	148	880	162	342	639	2,508
Indianapolis..........	968	808	731	644	183	805	115	240	602	2,469
Logansport	914	821	744	684	117	895	177	270	562	2,429
Richmond..............	914	736	659	576	224	788	70	308	669	2,536
Terre Haute............	1,041	881	804	717	182	866	188	167	556	2,408
Indian Ter.										
Vinita......................	1,572	1,412	1,335	1,258	647	1,171	705	364	381	2,117
Iowa.										
Burlington.............	1,232	1,089	1,012	952	207	1,099	423	202	294	2,161
Centreville.............	1,341	1,198	1,121	1,054	316	1,167	525	250	205	2,051
Des Moines.............	1,383	1,257	1,180	1,120	358	1,250	591	333	145	2,012
Dubuque................	1,215	1,090	1,013	962	190	1,177	484	349	339	2,206
Sioux City..............	1,542	1,417	1,340	1,289	517	1,424	811	507	101	1,968
Kansas.										
Atchison	1,490	1,330	1,253	1,166	509	1,241	637	324	153	1,963
Fort Scott..............	1,508	1,348	1,271	1,194	535	1,150	641	300	299	2,109
Leavenworth.........	1,488	1,328	1,251	1,164	507	1,220	635	303	174	1,984
Topeka	1,530	1,370	1,293	1,206	549	1,262	677	345	203	2,029
Wallace..............	1,883	1,723	1,646	1,559	902	1,615	1,030	698	556	1,676
Kentucky.										
Ashland	899	682	592	454	427	763	180	486	872	2,739
Frankfort...............	1,037	834	744	606	358	668	108	330	744	2,611
Henderson..............	1,147	987	910	807	303	745	254	172	586	2,453
Louisville...............	1,039	854	777	663	293	695	110	265	679	2,546
Paducah.................	1,265	1,080	1,003	889	415	771	336	200	614	2,481
Louisiana.										
Baton Rouge...........	1,650	1,433	1,343	1,205	887	870	853	672	1,053	2,369
Morgan City...........	1,641	1,424	1,334	1,196	995	861	906	780	1,095	2,40[illegible]
New Orleans...........	1,561	1,344	1,254	1,116	915	781	826	700	1,081	2,449
Shreveport..............	1,678	1,461	1,371	1,233	877	934	862	604	815	2,121
Vidalia	1,562	1,345	1,255	1,117	819	818	776	604	985	2,37[illegible]
Maine.										
Augusta..................	171	388	478	616	1,171	1,192	1,075	1,354	1,662	3,528
Bangor....................	245	462	552	690	1,245	1,266	1,149	1,428	1,736	3,603
Eastport	360	577	667	805	1,360	1,381	1,264	1,543	1,851	3,718
Portland.................	108	325	415	553	1,114	1,129	1,018	1,297	1,605	3,472
Vanceborough........	359	576	666	804	1,359	1,380	1,263	1,542	1,850	3,717
Maryland.										
Annapolis	445	228	138	42	814	618	595	936	1,288	3,155
Baltimore...............	405	188	98	40	803	616	579	920	1,272	3,139
Cumberland...........	584	367	277	152	620	728	401	742	1,094	2,961
Massachusetts.										
Boston...................	......	217	307	445	1,025	1,021	929	1,208	1,516	3,383
Fall River..............	49	211	301	439	1,044	1,015	955	1,257	1,535	3,392
Pittsfield.................	152	154	244	382	873	958	777	1,056	1,364	3,231
Springfield..............	101	138	228	366	924	942	828	1,107	1,415	3,282
Worcester..............	45	182	272	410	980	986	884	1,163	1,471	3,338
Michigan.										
Detroit...................	860	743	666	615	273	982	264	482	764	2,631
Grand Haven.........	1,001	884	807	756	177	1,041	323	460	668	2,535
Kalamazoo............	914	827	750	699	141	973	255	424	632	2,499
L'Anse...................	1,355	1,238	1,161	1,110	440	1,428	734	723	820	2,687
Lansing..................	913	793	719	668	220	1,015	297	477	711	2,578
Minnesota.										
Albert Lea...............	1,397	1,272	1,195	1,144	372	1,325	649	455	269	2,136

DISTANCES BY SHORTEST POST ROUTE—CONTINUED.

FROM POST OFFICE AT	TO POST OFFICES AT Boston, Mass...	New York, N. Y..........	Philadelphia. Pa.	WASHINGTON, D. C..........	Chicago, Ill...	Charleston, S. C..........	Cncinnati...... Ohio..........	St. Louis, Mo...	Omaha, Neb...	San Francisco, Cal..........
Breckenridge	1,642	1,517	1,440	1,389	617	1,605	911	787	588	2,258
Duluth....................	1,580	1,455	1,378	1,327	555	1,543	849	725	526	2,393
St. Paul..................	1,425	1,300	1,223	1,172	400	1,388	694	570	371	2.238
Winona..................	1,322	1,197	1,120	1,069	297	1,285	591	490	423	2,290
Mississippi.										
Bay St. Louis	1,543	1,326	1,236	1,098	947	729	869	732	1,133	2,501
Jackson..................	1,461	1,244	1,154	1,016	732	717	675	517	893	2,338
Meridian................	1,365	1,148	1,058	920	723	621	630	508	922	2,434
Vicksburg...............	1,505	1,288	1,198	1,060	741	761	707	526	907	2,294
Missouri.										
Hannibal...............	1,263	1,103	1,026	939	282	1,028	410	111	319	2,171
Jefferson City..........	1,333	1,173	1,096	1,019	376	1,042	466	125	326	2,168
Kansas City	1,462	1,302	1,225	1,138	481	1,194	609	277	200	2,010
St. Joseph...............	1,469	1,309	1,232	1,145	488	1,225	616	308	133	1,965
St. Louis................	1,208	1,048	971	894	283	917	341	......	414	2,281
Springfield..............	1,448	1,288	1,211	1,134	523	1,047	581	240	402	2,203
Montana.										
Dillon.....................	2,700	2,567	2,490	2,430	1,675	2,515	1,901	1,598	1,184	1,082
Glendive................	2,084	1,959	1,882	1,831	1,059	2,047	1,353	1,229	1,03	1.787
Helena...................	2,548	2,423	2,346	2,295	1,523	2,511	1 817	1,693	1,427	1,323
Nebraska.										
Lincoln..................	1,565	1,422	1,345	1,285	540	1,372	756	455	68	1,807
Omaha...................	1,516	1,383	1,306	1,246	491	1,331	717	414	......	1,867
Red Cloud..............	1,697	1,537	1,460	1,373	677	1,453	844	536	205	1,778
Sidney	1,930	1,797	1,720	1,660	905	1,745	1.131	828	414	1,453
Nevada.										
Carson City............	3,169	3,036	2,959	2,899	2,144	2,984	2,370	2,067	1,653	276
Elko	2,825	2,692	2,615	2,555	1,800	2,640	2,026	1,723	1,309	558
Pioche....................	2,921	2,788	2,711	2,632	1,896	2,688	2,103	1,771	1,405	1,206
Reno.......................	3,138	3,005	2,928	2,868	2,113	2,953	2,339	2,036	1,622	245
New Hampshire										
Concord..................	70	263	353	491	1,037	1,067	941	1,220	1,528	3,395
Keene.....................	93	212	302	440	962	1,016	866	1,145	1,453	3,320
Nashua	40	228	318	456	1,013	1,032	917	1,196	1,504	3.371
New Jersey.										
Cape May...............	389	172	82	220	905	796	749	1,053	1,388	3,255
Phillipsburgh..........	291	74	69	207	826	783	670	974	1,309	3 176
Trenton...........	274	57	33	171	856	747	700	1,004	1,339	3,206
New Mexico.										
Deming..................	2,596	2,391	2,301	2,163	1,632	1,857	1,696	1,388	1,286	1,198
Manuelito...............	2,556	2,396	2,319	2,232	1,575	2,148	1,703	1,371	1,229	1,023
Mesilla...................	2,555	2,350	2,260	2,122	1,615	1,816	1,655	1,347	1,269	1,287
Santa Fé.................	2,333	2,173	2,096	2,009	1,352	2,065	1,480	1,148	1,006	1,282
New York.										
Albany...................	203	142	232	370	822	946	726	1,005	1,313	3,180
Buffalo..................	501	410	414	437	524	1,013	428	707	1,015	2,882
Dunkirk..................	543	452	413	432	482	1,008	386	665	973	2,840
Elmira....................	404	264	268	296	670	872	574	853	1,161	3,028
New York...............	217	......	90	228	900	804	744	1,048	1,383	3,250
Rome.....................	312	247	337	432	713	1,008	617	896	1,204	3,071
West Point.............	239	48	138	276	916	852	792	1,096	1,407	3,274
North Carolina.										
Charlotte................	832	615	525	387	842	236	572	814	1,228	3,039
Raleigh..................	745	528	438	300	948	288	683	925	1,339	3,206
Weldon..................	648	431	341	203	939	373	657	998	1,384	3,251
Wilmington............	810	593	503	365	1,030	211	760	1,002	1,416	3,192
North Dakota.										
Bismarck................	1,863	1,738	1,661	1,610	838	1,826	1,132	1,008	809	2,027
Fargo......................	1,668	1,543	1,466	1.415	643	1,631	937	813	614	[illegible]

DISTANCES BY SHORTEST POST ROUTE—CONTINUED.

FROM POST OFFICE AT	TO POST OFFICES AT Boston, Mass...	New York, N. Y..........	Philadelphia, Pa..........	WASHINGTON, D. C..........	Chicago, Ill....	Charleston, S. C..........	Cincinna'i, Ohio..........	St. Louis, Mo...	Omaha, Neb...	San Francisco, Cal..........
Ohio.										
Cincinnati	929	744	667	553	294	718	......	341	717	2 584
Cleveland	685	568	491	440	340	962	244	523	831	2,698
Columbus	823	624	547	487	314	838	120	424	759	2,626
Crestline	761	620	543	492	280	886	168	447	770	2,639
Steubenville	691	474	397	346	444	922	270	574	909	2,776
Toledo	798	681	604	553	234	920	202	436	725	2,592
Youngstown	690	502	425	374	406	950	299	581	897	2,764
Oregon.										
La Grande	3,032	2,899	2,822	2,762	2,007	2,847	2,233	1,930	1,516	841
Portland	3,306	3,181	3,104	3,053	2,281	3,152	2,538	2,235	1,821	751
Roseburgh	3,503	3,378	3,301	3,250	2,478	3,349	2,735	2,432	2,018	554
Salem	3,359	3,234	3,157	3,106	2,334	3.205	2,591	2,288	1,874	698
Pennsylvania.										
Erie	588	484	447	450	437	1.026	341	620	928	2,795
Harrisburg	399	182	105	125	718	701	562	866	1,201	3,068
Philadelphia	307	90	......	138	823	714	667	971	1,306	3,173
Pittsburg	648	431	354	303	469	879	313	617	952	2,819
Scranton	362	145	165	260	793	836	646	950	1,284	3,151
Williamsport	453	236	199	218	680	794	524	828	1,163	3,030
Rhode Island.										
Newport	68	186	276	414	1,063	990	930	1.234	1,554	3.411
Providence	44	189	279	417	1,022	993	933	1,235	1,513	3,370
South Carolina.										
Charleston	1,021	804	714	576	988	......	718	917	1,331	3,055
Columbia	938	721	631	493	858	130	588	830	1,244	3.002
Florence	919	702	612	474	940	102	670	912	1,326	3,084
Port Royal	1,093	876	786	648	1,023	86	758	891	1,305	3,029
South Dakota.										
Canton	1,557	1,432	1,355	1,304	532	1,495	795	578	172	2,039
Deadwood	2,082	1,957	1,880	1,829	1,057	1,931	1,317	1,014	600	1,698
Pierre	1,806	1,681	1,604	1,553	776	1,719	1,075	802	397	2,264
Yankton	1,603	1,478	1,401	1,350	578	1.485	872	568	162	2,029
Tennessee.										
Bristol	828	611	521	383	691	475	421	663	1,077	2,944
Chattanooga	1,070	853	763	625	599	449	335	468	882	2,736
Knoxville	959	742	652	514	560	428	290	532	946	2,813
Memphis	1,380	1,163	1,073	935	521	759	487	306	687	2,426
Nashville	1,221	1,004	914	776	448	600	295	317	731	2,598
Texas.										
Austin	2,004	1,787	1,697	1,559	1,123	1,260	1,108	850	897	1,998
Beaumont	1,873	1,656	1,566	1,428	1,176	1,059	1,136	903	1,024	2,210
Denison.	1,794	1,599	1,509	1,371	869	1,146	904	586	603	1,998
El Paso	2,508	2,303	2,213	2,075	1,583	1,769	1,608	1,300	1,310	1,286
Galveston	2,006	1,789	1,699	1,561	1,143	1,192	1,128	870	991	2,177
San Antonio	2,084	1,867	1,777	1,639	1,203	1,340	1,188	930	977	1,918
Sherman	1,803	1,598	1,508	1,370	878	1,145	903	595	612	1,991
Utah.										
Frisco	2,828	2,695	2,618	2,539	1,803	2,595	2,010	1,678	1,312	1,113
Ogden City	2,549	2,416	2,339	2,279	1,524	2,364	1,750	1,447	1,033	834
Salt Lake City	2,585	2,452	2,375	2,315	1,560	2,400	1,786	1,483	1,069	870
Vermont.										
Bellows Falls	115	222	312	450	959	1,026	863	1,142	1,450	3,317
Montpelier	202	327	417	555	1,014	1,131	918	1,197	1,505	3,372
Wells River	164	302	392	530	1,039	1,106	943	1,222	1,530	3,397
White River Junc'n	139	262	352	490	999	1,066	903	1,182	1,490	3,357
Virginia.										
Clifton Forge	657	440	350	212	669	527	387	728	1,114	2,981
Lynchburg	624	407	317	179	752	444	470	811	1,197	3,064
Newport News	559	342	252	191	937	535	655	996	1,382	3,249

DISTANCES BY SHORTEST POST ROUTE—CONCLUDED.

FROM POST OFFICE AT	Boston, Mass...	New York, N. Y..........	Philadelphia, Pa.............	WASHINGTON, D. C...........	Chicago, Ill....	Charleston, S. C..........	Cincinnati, Ohio..........	St. Louis, Mo...	Omaha, Neb....	San Francisco, Cal..........
	TO POST OFFICES AT									
Norfolk..................	562	345	255	220	956	454	674	1,015	1,401	3,268
Richmond..............	561	344	254	116	862	460	580	921	1,307	3,174
Staunton...............	600	383	293	155	765	546	483	824	1,210	3,077
Washington.										
Colfax.....................	3,023	2,898	2,821	2,770	1,998	2,986	2,292	2,168	1,803	1,108
Kalama...................	3,346	3,221	3,144	3,093	2,321	3,192	2,578	2,275	1,861	791
Olympia..................	3,389	3,264	3,187	3,136	2,364	3,274	2,657	2,357	1,943	873
Tacoma..................	3,334	3,209	3,132	3,081	2,309	3,269	2,603	2,352	1,938	896
West Virginia.										
Charleston.............	833	616	526	388	493	703	211	552	938	2,805
Grafton..................	685	468	378	254	526	830	299	640	992	2,859
Harper's Ferry........	487	270	180	55	717	631	498	839	1,191	3,058
Huntington............	883	666	576	438	443	753	161	502	878	2,745
Parkersburg...........	789	572	482	358	426	913	195	536	871	2,738
Wheeling...............	713	496	419	353	456	929	251	566	901	2,768
Wisconsin.										
Ashland..................	1,454	1,329	1,252	1,201	429	1,417	723	655	556	2,423
Madison..................	1,163	1,038	961	910	138	1,126	432	361	456	2,323
Milwaukee.............	1,110	985	908	857	85	1,073	379	368	510	2,377
Prairie du Chien....	1,261	1,136	1,059	1,008	236	1,233	530	404	395	2,262
Wyoming.										
Cheyenne City........	2,032	1,899	1,822	1,762	1,007	1,847	1,233	930	516	1,351
Granger..................	2,393	2,260	2,183	2,123	1,368	2,208	1,594	1,291	877	990

Time of Transit of Mails Between Pacific Coast and Eastern Cities.

NOTE.—Time computed upon the basis of connections being made.

	Boston, Mass......	New York, N. Y.......	Philadel-phia, Pa...	WASHING-TON, D. C.	Chicago, Ill..........	Charleston, S. C.........	Cincinnati, Ohio.......	St. Louis, Mo........	Omaha, Neb........	San Fran-cisco, Cal.
	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.
Arizona.										
Prescott...........	143 50	136 00	134 00	134 20	112 55	149 45	110 50	98 30	98 00	52 45
California.										
Los Angeles......	130 00	126 00	124 00	124 00	113 25	127 45	113 50	101 30	101 30	22 45
Sacramento......	119 30	115 30	115 40	119 00	90 50	141 45	121 30	110 00	75 40	4 00
San Francisco..	123 30	119 30	119 40	123 00	94 50	145 45	125 30	114 00	79 40	......
Colorado.										
Denver............	73 20	66 30	63 40	64 30	40 55	87 15	45 00	33 10	20 30	75 45
Idaho.										
Boise City.........	127 30	120 30	120 40	124 00	91 50	144 50	104 00	103 35	76 40	68 15
Montana.										
Helena............	85 30	81 00	82 00	85 00	57 20	125 15	61 00	70 00	59 00	68 00
Nevada.										
Carson City......	119 35	115 15	112 00	115 00	86 25	133 45	98 00	87 00	72 00	15 15
New Mexico.										
Santa Fé..........	96 50	89 00	86 35	89 25	62 55	101 45	62 55	52 30	52 30	73 45
Oregon.										
Portland..........	126 20	121 30	121 30	124 30	92 50	145 45	100 20	99 50	74 00	39 45
Salem...............	128 20	123 30	123 30	126 30	94 50	147 45	102 20	101 50	76 00	37 45
Utah.										
Salt Lake City..	89 30	89 30	86 40	71 00	58 30	109 45	69 00	67 30	43 00	49 15
Washington.										
Tacoma...........	124 00	124 55	124 10	127 25	93 15	148 10	107 25	94 05	71 15	48 25
Olympia...........	129 00	123 55	125 10	128 25	96 15	149 10	108 25	95 05	72 15	48 35

PRECIOUS STONES.

List of Gem Stones Known to be Found in the United States.

Achroïte (*Tourmaline*).
Agate (*Quartz*).
Agatized wood (*Quartz*).
Almandine (*Garnet*).
Amazon stone (*Microcline*).
Amber.
Amethyst (*Quartz*).
Aquamarine (*Beryl*).
Asteria.
Beryl.
Bloodstone.
*Bowenite (*Serpentine*).
Cairngorm (*Quartz*).
Catlinite.
Chalcedony (*Quartz*).
Chiastolite.
*Chlorastrolite.
*Chondrodite.
Chrysolite.
Danburite.
Diamond.
Diopside (*Pyroxene*).
Elæolite (*Nephelite*).
Emerald (*Beryl*).
Epidote.
Essonite (*Garnet*).
Fléche d'amour (*Quartz*).
Fluorite.
Fossil coral.
Garnet.
Grossularite garnet.
Heliotrope.
Hematite.
*Hiddenite (*Spodumene*).
Hornblende in quartz.
Idocrase.
Indicolite (*Tourmaline*).
Iolite.
Isopyre.
Jade.
Jasper (*Quartz*).
Jet (*Mineral coal*).
Labradorite.
Labrador spar (*Labradorite*).
Lake George diamonds (*Quartz*).
*Lithia emeralds (*Spodumene*).
Macle.
Malachite.
Moonstone (*Feldspar Group*)
Moss agate (*Quartz*).
*Novaculite (*Quartz*).
Obsidian.
Olivine (*Chryolite*).
Opalized wood (*Opal*).
Peridot (*Chrysolite*).
Phenakite.
Prehnite.
Pyrope (*Garnet*).
Quartz.
Rhodonite.
Rock crystal (*Quartz*).
Rose quartz (*Quartz*).
Ruby (*Corundum*).
Rubelite (*Tourmaline*).
*Rutile.
Rutile in quartz (*Quartz*).
Sagenite (*Quartz*).
Sapphire (*Corundum*).
Silicified wood (*Quartz*).
Smoky quartz (*Quartz*).
Smoky topaz (*Quartz*).
Spinel.
Spodumene.
Sunstone (*Feldspar*).
*Thetis hair stone (*Quartz*)
*Thomsonite.
Tourmaline.
Topaz.
Turquois.
Venus hair stone (*Quartz*)
*Willemite.
*Williamsite (*Serpentine*).
Wood agate (*Quartz*).
Wood jasper (*Quartz*).
Wood opal (*Opal*).
Zircon.
*Zonochlorite (*Prehnite*).

The following complete the list of precious stones known to exist in the U. S. at the close of 1893: Anthracite, Arrow points, Catlinite, Pyrite, and Trilobite.

* Gem stones found only in the United States.

Species and varieties found in the U. S. but not in gem form.

Axinite.	Cassiterite.	Cyanite.	Opal.	Sphene.
Andalusite.	Chrysoberyl.	Ilvaite.	Prase (*Quartz*).	Titanite.

Species and varieties not yet identified in any form in the U. S.

Alexandrite.	Cat's-eye quartz.	Demantoid.	Lapislazulite.
Cat's-eye chrysoberyl.	Chrysoprase.	Euclase.	Ouvarovite.

Estimated production of precious stones in the U. S. in 1893.

[*Details of value only.*]

Agate, $1,000; Amazon-stone, $1,000; Anthracite, $3,000; Beryl, $500; Catlinite (pipestone), $5,000; Chlorastrolite, $500; Fossil Coral, $1,000; Garnet, $2,000; Moss Agate, $2,000; Pyrite, $1,500; Quartz, $10,000; Sapphire Gems, $10,000; Silicified Wood, $1,250; Smoky Quartz, $5,000; Thomsonite, $500; Topaz, $100; Tourmaline, $5,000; Turquoise, $143,136. During 1893 some work was carried on at Mount Mica, Paris, Me., which resulted in the discovery of a number of large green crystals, one of which furnished one of the finest tourmaline ever found on this continent, being of a clear grass green color and weighing 63½ carats. About $20,000 worth of sapphire was sent abroad in 1892, but during 1893 more Montana sapphires were actually sold than in any previous year, probably on account of the company having a lapidary at the World's Columbian Exposition, where these stones were cut and sold. The largest diamond known to have been found in the U. S. was at Manchester, Va.; it weighed 10 carats after it was cut, and was valued in the rough at $5,000; a 3-carat stone was found near San Francisco, Cal., and recently a diamond weighing 3 14/16 carats was found in Wisconsin; a number have also been found in Butte and Shasta Co.'s, Cal., and three on Pebble Beach, Pescadero, Cal., one of which was valued at $300 in the rough state. It is interesting to note that, in spite of the financial depression, $143,136 worth of American turquoises were sold in 1893, a greater amount probably than has ever been sold from the Persian mines in a single year. The importation of precious stones into the U. S. has steadily increased from about $1,318,000 worth in 1867, to $14,521,851 in 1892, and $10,197,505 in 1893.

SYMBOLS OF ELEMENTS.

Elements.	Symbols	Elements.	Symbols	Elements.	Symbols
Aluminium	Al	Hydrogen	H	Rhodium	Ro
Antimony	Sb	Indium	In	Rubidium	Rb
Arsenic	As	Iodine	I	Ruthenium	Ru
Barium	Ba	Iridium	Ir	Selenium	Se
Bismuth	Bi	Iron	Fe	Silicon	Si
Boron	Bo	Lanthanium	La	Silver	Ag
Bromine	Br	Lead	Pb	Sodium	Na
Cadmium	Cd	Lithium	L	Strontium	Sr
Cæsium	Cs	Magnesium	Mg	Sulphur	S
Calcium	Ca	Manganese	Mn	Tellurium	Te
Carbon	C	Mercury	Hg	Terbium	Tb
Cerium	Ce	Molybdenum	M	Thallium	Tl
Chlorine	Cl	Nickel	Ni	Thorium	Th
Chromium	Cr	Niobium	Nb	Tin	Sn
Cobalt	Co	Nitrogen	N	Titanium	Ti
† Columbium	Ta	Norium	No	Tungsten	W
Copper	Cu	Osmium	Os	Uranium	U
Didymium	D	Oxygen	O	Vanadium	V
Erbium	E	Palladium	Pd	Yttrium	Y
Fluorine	F	Pelopium	Pe	Zinc	Zn
Glucinum	Gl	Phosphorus	P	Zirconium	Zr
Gold	Au	Platinum	Pt		
		Potassium	K		

† Identical with Tantalum.

BIBLICAL WEIGHTS, MEASURES AND MONEY—Weights.

Weights.		Equivalent Troy.	Weights.		Equivalent Troy.
1 Gera	=	117.41 grains	1 Maneh	=	234,828.16 grs., or 36.70 lbs.
1 Beka	=	1,174.14 "	1 Talent	=	704,484.50 grs., or 122.34 lbs.
1 Shekel	=	2,348.28 "			

Measures of Length and Capacity.

A day's journey was	= 33.20 miles	1 Log = ½ pint; 1 cab = 3 pints
A Sabbath day's journey	= 2.13 miles	1 Omer = 3 quarts; 1 firkin = 7 pints
A cubit was nearly	= 22.00 inches	1 Hin = 1 gallon and 2 pints
6 cubits = 1 great cubit or	= 11.00 feet	1 Epah or bath = 7 gallons and 2 quarts
A finger's breadth	= 1.00 inch	1 Homar = 75 gallons and 5 pints.

Money.

Denomination.	Gold.	Silver.	Copper.	Denomination.	Gold.	Silver.	Copper.
Gerah	$ 0.28.45	$ 0.02.65	$ 0.00.17	Maneh	$ 569.00	$ 53.00	$ 3.145
Beka	2.84	0.26.50	0.01.642	Talent	17,070.00	1,590.00	94.28
Shekel	5.69	0.53	0.03.143				

Relative value of Biblical metals—Gold at 14 = 160 Silver = 764 Copper.

Ancient Money (*Not Biblical*).

Money.		Grs. Troy.		Gold Val'e.
Persian Daric (Drams)	=	128 grains	=	$5.52
Maccabæn Shekel (silver)	=	220 "	=	.53
"Piece of money" (Stater silver)	=	220 "	=	.53
Penny (Denarius, silver)	=	58.85 "	=	.14
Farthing (Quadrans, copper	=	42 "	=	.0025

Money.		Grains Troy.	Gold Value.
Farthing (Assarium, copper)	=	84 grains	$ 0.0050
Mite (copper)	=	21 "	.00125

A Piece of Silver or a Penny was 15 cents.
A Farthing (silver) was 3 cents.
A Gera was 2 cents.
A Mite was ½ a cent.

MINERAL SUBSTANCES AND THEIR COMPOSITION.

Actinolite—(Ray Stone)—Is found in boulders, or rolled masses; also with garnets, in fine needle crystals, and in quartz, which when broken show beautiful green radiating crystals. See Amphibole.

Agalmatolite or **Agalmamolite** (Pagodite)—A variety of pinite, hydrous silicate of alumina, magnesia, iron, lime, soda and potash. It is soft and appears like soapstone; much used for ornamental carved work by the Chinese.

Agate—A semi-pellucid uncrystallized variety of quartz combining various tints.

Alabaster—A compact variety of sulphate of lime, or gypsum of fine texture, and usually white, but sometimes yellow, red or gray.

Alaskaite—Occurs in quantity as massive mineral with tetrahedrite, chalcopyrite, barite and quartz. (Symbol A.)

Albite—A species of mineral of the feldspar family; contains silicate of alumina and soda; color white; composition, silica 68.6, alumina 19.6, soda 11.8.

Altaite—Telluride of lead; composition, lead 61.7, tellurium 38.3=100.

Alum—(Tchermignite)—A double sulphate of alumina and potassa; composition, sulphate of potash 1, ter-sulphate of alumina 1, water 24 parts=26.

Aluminium or **Aluminum**—The metallic base of alumina; white, with a bluish tinge, specific gravity only about 2.6.

Alunogen—Sulphate of Alumina; found on the Verde river, Arizona.

Amber—A yellowish resin resembling copal; a fossil; friction electrofies it.

Amethyst—A sub-species of quartz, of a bluish-violet color, of different degrees of intensity, generally occurs crystallized in hexahedral prisms.

Amianthus—Amphibole. See Asbestus.

Amphibole—Actinolite, Anthophyllite, Amianthus, Asbestus, Hornblende, Mountain Cork, Mountain Leather, Tremolite, etc.—Is an anhydrous silicate of various bases—iron, magnesia, lime, etc., and a little water.

Amphibolite—Trap, or greenstone; base of Amphibole or Hornblende.

Andalusite—Is a silicate of alumina, containing sometimes sesquioxide of iron, magnesia, lime, soda, potash and manganese in varying proportions; when pure, it contains silica 36.8, alumina 63.2 parts=100.

Anglesite—Native sulphate of lead, occurs in white or yellowish prismatic crystals.

Anhydrite—Anhydrous gypsum.

Anorthite—Of the feldspar family, occurring in small glossy crystals.

Anthophyllite—So named from its clove-brown color. See Amphibole.

Antimony—The gray ore, contains sulphur and antimony, is of a tin-white color, and brittle.

Apatite—Native phosphate of lime, usually six-sided prisms, of a greenish color.

Aragonite—Identical with calcite or carbonate of lime, but harder, crystallizing in prismatic forms. See Tufa.

Aragotite—A hydro-carbon, peculiar to the quicksilver mines of California; found in dolomite and with cinnabar; identical with Idrialite. See Petroleum.

Argentite—Silver Glance, Sulphuret of Silver, Vitreous Silver.—color, dark lead, gray, opaque; luster, metallic; composition, silver 87.1, sulphur 12.9=100.

Arsenic—A metal of a steel-gray color, brilliant luster, dull from tarnish; very brittle, and sublimes at 356° Fahr.; specific gravity from 5.7 to 5.9; it is sometimes found native, but usually combined with silver, cobalt, nickel, iron, antimony and sulphur.

Arsenolite—An oxide of arsenic; composition, arsenic 75.76, oxygen 24.24= 100 parts.

Arsenopyrite or **Mispickel**—Luster, metallic; color, grayish-white to almost silver white; quite brittle; composition, arsenic 46.0, iron 34.4, sulphur 19.6 =100 parts.

Asbestus—A mineral unaffected by fire; a variety of hornblende and pyroxene; found in long, delicate fibers, or fibrous masses or seams; color, white or gray, but sometimes greenish or reddish. See also Mountain Cork, Mountain Leather, Rock Cork, Tremolite, etc.

Asboline—Earthy cobalt, with lead ores, carrying 10 to 11 per cent. of nickel.

Asphaltum—Mineral pitch, Jew's pitch, or compact native bitumen; brittle, black or brown color, and high luster on a surface of fracture. See Aragotite, Bitumen, Idrialite and Petroleum.

Atacamite—A native oxychloride of copper (a rare mineral,) originally found in the form of sand, in the desert of Atacama, Chile; reported to have been found in Inyo Co., California.

Augite—Diallage, Diopside, Omphazite, Sahlite, etc. See Pyroxene.

Aurichalcite—Brass ore, found with other zinc ores in Arizona.

Axinite—Thumite—A mineral occurring in brilliant glassy crystals; it consists chiefly of silica, alumina, lime, and peroxide of iron.

Azurite—Blue carbonate of copper, a hydrous carbonate of copper, composition, oxide of copper 69.2, carbonic acid 25.6, Water 5.2=100 parts. See Azure Copper, Chessy Copper, Blue Malachite, and Mt. Blue.

Barytes or **Barite**—Sulphate of baryta, generally called heavy spar.

Barytum or **Barium**—The metallic basis of baryta or baria, oxide of barium.

Barnhardtite—Sulphide of copper and iron, abundant with other copper ores.

Bernardinite—A resin found in San Bernardino Co., Cal., *new*, but little known.

Berthierite—Sulphide of antimony and iron, associated with argentiferous ores.

Beryl—A mineral of great hardness, and when transparent, of much beauty. It occurs in green or bluish-green, six-sided prisms, and consists of silica, alumina, and the rare earth glucina; colored by oxide of iron. As a gem, *aqua-marine*.

Bindheimite—A hydrous antimoniate of lead; composition, oxide of antimony 31.71, oxide of lead 61.38, water 6.46=99.55 parts.

Biolite—Hexagonal Mica. **Biotite**—Brown Mica. See Mica.

Biotine—A variety of anorthite found in the volcanic debris of Vesuvius.

Bismuth—A metal of a reddish white color, crystallizing in rhombohedrons, nearly like cubes. It is harder than lead, rather brittle; specific gravity 8. Melts at 476° Fahr.

Bismuthine or **Bismuthinite**—Sulphate of bismuth. A rare mineral, composed of bismuth and sulphur,

Bismuthite--Bismuth ochre; found in small quantities in South Carolina.

Bitumen—Mineral pitch, a substance having a pitch-like odor, and burning readily with a bright flame, without residue. See Asphaltum, Petroleum, etc.

Black Jack or **False Galena**—Sulphuret of zinc, consisting of sulphur, zinc, and a little iron; zinc blende. See Sphalerite.

Blende—An ore of zinc, called also *mock lead*, *false-galena* and *black jack*. It is a sulphuret of zinc, consisting, when pure, of zinc 67 parts and sulphur 33, but often containing some iron. Its color is usually yellow, brown or black, and its luster resinous.

Bloodstone—A green silicious stone sprinkled with red jasper; called also Heliotrope. See Hematite.

Borax—Bi-borate of soda, native borax, tincal, etc,; a salt formed by a combination of boracic acid, with soda; color, white, grayish, or with a shade of blue and green.

Bornite—Erubescite, horseflesh ore, purple copper ore, variegated copper, etc.; a double sulphide of copper and iron; elements vary in different specimens; composition (average,) copper 58.20, iron 14.85, sulphur 26.98=103 parts.

Boron—An elementary substance, nearly related to carbon, of a deep olive color, infusible, and not a conductor of electricity. At a red heat it burns, uniting with oxygen, and forming boracic acid. Is found in nature in borax, boracite, datholite, tourmaline, etc.

Braunite—Manganese ore. See Manganese, Pyrolusite, etc.

Breunerite or **Brown-Spar**—A crystallized variety of dolomite; reddish-brown color, tinged with oxide of iron and manganese.

Brogniardite—Associated with other argentiferous ores. [E. Stahl, Arizona,]

Bromine—One of the elements chemically related to chlorine and iodine; a deep reddish-brown liquid of a disagreeable odor. Is also found in a silver ore of Chile.

Brookite—Arkansite, Titanic Acid. See Titanium.

Brucite—Native hydrate of magnesia (incorrectly called chondroite); a white, pearly mineral, occurring thin and foliated, like talc, and also fibrous.

Cadmia—An oxide of zinc (incorrectly called calamine.) See Calamine.

Cadmium—A metal related to zinc; color white, and both ductile and malleable; found in some zinc ores.

Cæsium—An alkaline metal first discovered in mineral waters.

Calamine—A mineral, the silicate of zinc. See Cadmia.

Calaverite—A rare mineral (first found in Calaveras Co., Cal.,) is a telluride of gold and silver; composition (about), tellurium 56.00, gold 40.92, silver 3.08=100 parts. See Tellurium.

Calcite—Calc-spar, Gay-Lussite, Thinolite, Travertine, Tufa; carbonite of lime, consisting of lime and carbonic acid. It includes common limestone, with all the white and most of the colored marbles.

Caledonite--Impure sulphate of lead; occurs with other lead ores.

Calcium—The metallic basis of lime.

Carbon—An elementary substance, not metallic in nature; predominates in all organic compounds. It is combustible, and forms the base of CHARCOAL, and enters largely into mineral coals. In its pure, crystallized state it constitutes the DIAMOND, and is the hardest of known substances. It enters largely into graphite, or black lead, and in this it is soft, and occurs in hexagonal prisms or tables.

Carbonite—Natural Coke, Coke, Coak.

Carrollite—Cobalt ore; occurs in small quantities with chalcopyrite and chalcocite.

Cassiterite—Tin Ore, Tin-stone, Binoxide of Tin; atomic weight 74; composition, tin 78.67, oxygen 23.33=102.

Cat's-Eye—A variety of quartz or chalcedony, exhibiting yellowish opalescent reflections from within, somewhat like the eye of a cat, produced by filaments of asbestus.

Celestine or **Celestite**—Native sulphate of strontia (or strontian), a mineral, so named from its occasional delicate blue color.

Cerargyrite—A chloride of silver, horn silver; composition, chlorine 24.7, silver 75.3 =100 parts.

Cerium—A metal of high specific gravity, grayish-white color, and lamellar texture. It exists in the mineral *allanite, cerite, gadolinite,* etc.

Cerasite—The native muriate of lead. See Cerusite.

Cerusite—Carbonate of lead, white lead, white lead ore; composition, carbonic acid 16 5, oxide of lead, 83.5 = 100 parts. Is also known as carbonate, hard carbonate, sand carbonate, etc.; is usually argentiferous, and in Colorado is mined for both silver and lead.

Cervantite—Antimony ocher, occurs with stibnite and other antimony ores.

Ceylanite—A dingy-blue or grayish-black variety of spinel. Also called pleonast.

Chabasite—A mineral occurring in glassy-rhombohedral crystals, nearly the form of a cube; also, in double six-sided pyramids; colorless, or tinged with red or yellow; composition, alumina, lime, silica, and 20 per cent. of water

Chalcanthite—Blue Stone, Blue Vitriol, Native Sulphate of Copper. See Copper.

Chalcedony—An uncrystallized translucent variety of quartz, of a whitish color, and a luster nearly like wax. See Heliotrope.

Chalcosite or **Chalcocite**—Copper Glance, Vitreous Copper; is a sulphide of copper; composition, sulphur 20.2, côpper 79.8 =100 parts.

Chalcopyrite—Copper Pyrites, Yellow Copper Ore; this mineral is a double sulphide of copper and iron; composition, sulphur 34.9, copper 34.6, iron 30.5, =100 parts.

Chromite—Chromic Iron, Chrome Ore; a black sub-metallic ore consisting of oxide of chromium and iron; composition (average,) protoxide of iron 27.53, magnesia 6.50, alumina 9.57, sesquioxide of chromium 53.62, silica (and loss) 2.78=100 parts.

Chromium—A hard brittle metal of a grayish-white color, very difficult of fusion, and related to iron in many of its properties.

Chrysoberyl—A yellowish-green gem, next to a sapphire in hardness, and consisting of alumina and the earth glucina.

Chrysocolla—The green or blue carbonate of copper; it is a hydrous silicate of copper; when pure, its composition is oxide of copper 45.3, silica 34.2, water 20.5=100 parts.

Chrysolite—A mineral, composed of iron, magnesia and silica, varying in color from a pale green to a bottle-green; occurring in glassy grains disseminated in basalt and many lavas, sometimes in large imbedded crystals and other rocks.

Chrysotile—(Peridot)—A magnesian mineral, a variety of serpentine, of no value,

Cinnabar—A red sulphuret of mercury or quicksilver, occurring native, in brilliant red crystals, and also in amorphous masses of different shades of red and brown. See Mercury and Quicksilver.

Cinnamon-Stone or **Essonite**—A variety of garnet, of a cinnamon color.

Coal—Anthracite, Ionite, Lignite, Mineral coal, etc. A black, or brownish black, solid, combustible substance, consisting, like charcoal, mainly of carbon, but more compact, and often containing a large proportion of bitumen. **Anthracite**, or *Glance Coal,* that containing little or no bitumen, and therefore burning with very little flame. **Bituminous** *Coal,* that containing from 10 to 50 per cent of bitumen. **Cannel** *Coal,* a very compact bituminous coal, of fine texture and dull luster, and burns with a beautiful white flame. **Ionite** is a hydro-carbon mineral, first found in Ione valley, Cal.; when first found it contains 50 per cent. of water, but when air-dried it floats on water; specific gravity about .9; melts to a pitch-like mass, which burns easily with a dense black smoke, having a resinous aromatic odor and with a yellow flame. **Lignite**, or *Brown Coal,* that variety that has something of the woody texture apparent, and an empyreumatic odor; any coal of later formation than that of the true coal era.

Cobalt—A metal of a reddish-gray color; brittle; difficult of fusion; specific gravity (about) 7.8; it has not been found native, but combined with arsenic, or its acid, with iron, nickel and sulphur. The ores of metallic lustre are white, grayish, or very slightly reddish. **Cobalt-bloom**, a cicular arseniate of cobalt. **Cobalt-blue**, a compound of phosphate of cobalt and alumina.

Cobalt-crust, earthy arseniate of cobalt. **Cobalt-green**, a preparation of cobalt and iron, having a green color; see Erythrite, and Millerite.

Cobaltine—A crystallized mineral, of a nearly silver-white color, composed chiefly of arsenic, cobalt and sulphur.

Cobaltite—Cobalt Glance, found in earthy cobalt and lead ores in clay slate.

Coccinite—Iodide of mercury, found in San Emidio Cañon, Kern Co., Cal.

Colemanite or **Priceite**—From the mean of three analyses, by Prof. Silliman, the composition is—Boracic acid 49.00, Lime 31.83, Water 18.29, Alumina, Salt, and Oxide of Iron .96=100.08 parts. Two samples analyzed by Thos. Price, averged—Boracic acid 46.13, Lime 29.88, Water 23.87, Alkalies .12=100.

Columbium—A rare metal first discovered in an ore or oxide, found at New London, Conn.; also called Niobium and Tantalum.

Copper—A metal of a reddish color, ductile, malleable and tenacious. It is among the most elastic and sonorous of the metals. It fuses at 2,000° Fahr.; specific gravity 8.8 to 8.9; it is found native, and in various ores.

Copperas—Coquimbite, in part hydrous sulphate of iron; sulphate of iron, or green vitriol; a salt of a green color, and styptic, astringent taste.

Corundum—The earth alumina, as found native in a crystalline state, including **Sapphire**, the blue variety; **Oriental Ruby**, or red sapphire; **Oriental Amethyst**, or purple sapphire; **Adamantine Spar**, the hair-brown variety; when combined with manganese and other impurities it becomes **Emery**. It is the hardest known substance next to the diamond.

Covellite or **Indigo Copper**—Is a compound of sulphur and copper, of a dark indigo color; in Alabama is found with pyrite and quartz.

Crednerite—Oxide of manganese and copper.

Crocoicite or **Crocoite**—The chromate of lead, red-lead ore.

Cuban—Sulphate of copper and iron; brownish appearance, and resembles chalcopyrite.

Cuprite—The red oxide of copper; red copper.

Cuproscheelite—This mineral is a tungstate of lime and copper, found massive, and in well defined crystals; homogeneous, yellowish-green color. Composition: Tungstic acid 79.69, Oxide of Copper 6.77, Lime 10.95, Protoxide of Iron .31, Water 1.40=99.12 parts.

Datolite or **Datholite**—Is a silicate of lime, containing from 18 to 22 per cent. of boracic acid, found in trappean rocks—gneiss, diorite, and serpentine.

Dechenite or **Descloizite**—Vanadate of lead; found with other lead ores.

Diallogite—Rhodochrosite, carbonate of manganese, in pink crystals.

Diamond—A mineral and gem remarkable for its hardness, as it scratches all other minerals. It is pure carbon crystallized. Chemically it does not differ from charcoal, and is also nearly identical in composition with graphite. Its specific gravity is 3.529 to 3.55. Diamonds are not always colorless, but sometimes tinged with yellow, red, orange, green, brown, blue, rose-red, and often black. The diamond can be crushed with a hammer, or split on the edge of a knife; a fact, not generally known.

Didymium—A rare metal related to Cerium, in the ores of which it is found; also with the ores of Lantanium.

Dioptase—An ore of copper, consisting of silica and copper, with 12 per cent. water. It is found in rich, emerald-green crystals.

Dolomite—Carbonate of lime and magnesia; when pure the composition is: Carbonate of lime 54.35, Carbonate of magnesia 45.65=100.

Domeykite—Arseniuret of copper; a mineral found in Peru.

Dufrenite—Hydrous phosphate of iron; a kind of iron ore.

Dufrenoysite—Sulpharsenide of lead; composed of sulphur, arsenic and lead.

Dyscrasite—Antimonide of silver; associated with other ores of lead and silver.

Dysclasite—A mineral, usually fibrous, of a white or yellowish color and somewhat pearly luster, consisting chiefly of silicate of lime; so-called from its great toughness.

Embolite—Chlorobromide of silver; color dark green.

Enargite—A sulpho-arsenide of copper, sometimes containing antimony, iron, silver or zinc.

Enstatite—A silicate of magnesia, alumina, iron, lime, manganese, etc. The variety "Bronzite" is found in Alameda County, California.

Epidote—Is a silicate of alumina, iron, lime, etc.; rare in California.

Epsomite—Epsom salt, hair salt, sulphate of magnesia. Composition: Magnesia 16.3, Sulphuric Acid 32.5, Water 51.2=100.

Erbium—(Terbium, Yttrium)—A metal found in ores of Yttrium.

Erubescite—Variegated copper; is found in the copper mines of New Jersey.

Erythrite—Arseniate of Cobalt, Red Cobalt Ore; a rare mineral.

Eucairite—A mineral, consisting principally of selenium, copper and silver.

Euchroite—Arseniate of copper; a mineral of a light emerald-green color.

Euchysiderite—Pyroxene; containing silica, lime, magnesia and oxide of iron.

Euclase—A brittle gem of the beryl family; consisting of silica, alumina and glucina.

Eudialyte—A mineral containing silicates of iron, zirconia and lime; of a brownish-red color, and vitreous luster; easily dissolved in acids.
Eulytine—Consisting chiefly of the silicate of bismuth, found at Freiburg.
Exanthalose—Native sulphate of soda; an efflorescence in certain lavas.
Fahlerz—Tetrahedrite. Gray Copper, or gray copper ore; it contains copper, antimony, arsenic and sulphur.
Feldspar—See Albite, Labradorite, and Orthoclase. A mineral occurring in crystals and crystalline masses, somewhat vitreous in luster, colors are white, flesh-red, and sometimes bluish or greenish. It consists of silica, alumina, and potash; and is one of the essential constituents of granite, gneiss, mica-slate, porphyry, etc., and nearly all volcanic rocks.
Fire-Clay—Chiefly pure silicate of alumina, capable of sustaining great heat.
Fluorite—Fluoride of Calcium, Fluor Spar; occurs in small white cubes, with copper ore, at Mt. Diablo, Cal.
Franklinite—A mineral compound of iron, manganese and zinc; found in N. J.
Freibergite—Argentiferous Tetrahedrite; found in Sawtooth District, Idaho.
Freieslebenite—Antimonial sulphide of silver. Abundant in Ariz. [E. Stahl.]
Gadanolite—See Erbium. A mineral; black, or greenish-black color, and vitreous luster; containing the silicate of cerium, iron and Yttrium.
Galena or **Galenite**—Lead, lead ore, lead dross. A sulphuret of lead; color, lead-gray; luster, highly metallic. Composition: Lead 86.6, Sulphur 13.4.
Garnet—A mineral, usually occurring in symmetrical, twelve-sided crystals (dodecahedrons), of a deep-red color. There are also black, brown, green and yellow varieties. Composition: Alumina, lime and silica, with more or less oxide of iron and manganese. Other varieties are, Allochroite, Colophonite, Grossular, Melanite and Ouvarovite; the latter of an emerald-green color.
Gay-Lussite—Is a carbonate of lime and soda found in alkaline lakes in fine crystals. A yellowish-white translucent mineral.
Geocronite—Sulphide of lead and antimony; a lead-gray or grayish-blue mineral, with a metallic luster, consisting of antimony, lead and sulphur, with traces of arsenic.
Glauberite—Sulphate of lime, and soda, found in borax, salt and soda mines; occurs in flattened, oblique crystals, somewhat glassy, and of a yellowish or grayish color.
Glaucolite—A greenish-blue variety of scapolite, consisting of the silicates of alumina and lime.
Glauconite—The green mineral which gives the peculiar character to the *green sand* of the chalk and other formations.
Glaucophane—This mineral occurs in a rock matrix, widely distributed in California, and associated with serpentine; first observed in 1877.
Glucinium or **Glucinum**—A metal which appears in the form of a grayish-black powder, and acquires a dark, metallic luster by burnishing. It occurs in nature only in combination with silicic acid.
Gold—Is a precious metal of a reddish-yellew color, is not acted upon by nitric acid, and it fuses B. B. to a bright bead on charcoal without incrustation. In sufficiently large pieces, it may be recognized by being malleable under the hammer, and cutting with the knife without crumbling. The atomic weight of gold is 196.5, hydrogen being taken as unity. It fuses at 2016° Fahr.; its specific gravity 19.258, which may be increased to 19.376 by hammering. Iridium and Platinum (hammered) are the only metals heavier than gold.
Grahamite—Asphalt. See Asphaltum
Granite—A crystalline, unstratified rock, consisting of quartz, feldspar and mica, and presenting usually a whitish, grayish or flesh-red color. It differs from gneiss in not having the mica in planes, and therefore in being destitute of a schistose structure. The varieties of granite are: *Gneissoid Granite*, in which the mica has traces of a regular arrangement. *Graphic Granite*, consisting of quartz and feldspar, without mica, and having the particles so arranged in the feldspar as to appear, in a transverse section, like oriental characters. *Porphyritic Granite*, containing feldspar in distinct crystals. *Seynitic Granite*, containing hornblende as well as mica.
Graphite—Black Lead, Plumbago, etc.; is carbon in one of its conditions, usually crystallizing in foliated six-sided prisms, though often massive; is soft; luster, metallic, of a dark-lead color, and sometimes contains iron.
Greenockite—Sulphide of Cadmium; see Cadmium.
Greensand—(often called Marl)—Is a variety of sandstone, usually imperfectly consolidated, consisting largely of green particles of a mineral called Glauconite.
Groroilite—An earthy ore of manganese, in roundish masses of a blackish-brown color.
Grossular or **Grossularite**—A translucent garnet of a pale-green color; known as lime garnet, and often mistaken for tin ore
Gurhofite—A compact, snowy-white, subtranslucent variety of dolomite.

Gymnite—A hydrous silicate of magnesia.

Gypsum—(Ancient name, Alabaster)—Satin Spar, Selenite, Plaster of Paris when calcined. This mineral is a hydrous sulphate of lime. Composition: Sulphuric Acid 46.5, Lime 32.6, Water 20.9=100. Color: white, gray, pink, yellow, blue, and sometimes black; transparent to opaque.

Halite—Chloride of Sodium, Common Salt, Rock Salt.

Halloysite—Occurs in cherty strata of lower subcarboniferous; and is mined extensively for the manufacture of fine ware, in DeKalb and Jackson Counties, Alabama.

Hansmannite—Black Manganese, Black Oxide of Manganese.

Heliotrope—A variety of chalcedony, of a deep-green color, variegated with blood-red or yellowish spots.

Hemachate—A species of agate, sprinkled with spots of red jasper.

Hematite—Hæmatitis, Micaceous Iron, Oligist Iron, Red Hematite, Red Oxide of Iron, Sesquioxide of Iron, Specular Iron, and Rhombohedral Iron Ore. Composition: Iron 70, Oxygen 30=100. Brown Hematite, a brown ore of iron.

Hessite—Telluride of Silver.

Hornblende—(See Amphibole)—The green variety is called *Actinolite;* the fibrous, *Asbestus;* the white, *Tremolite;* and the black, *Hornblende.*

Humboldtilite—A variety of mellite, found in the lava of Vesuvius, and consisting chiefly of alumina, lime and silica.

Humboldtine—Oxalite, a native oxalate of iron.

Humboldtite—Borosilicate of lime, a rare variety of datholite.

Hyacinth—(See Zircon)—A red variety of zircon, sometimes used as a gem.

Hyalite—(Müller's Glass)—A pellucid variety of opal, looking like colorless gum of resin.

Hydraulic Lime—Cement Rock, Water Lime. An insoluble silicate of alumina, composed partly of lime.

Hydrogen—A gas which constitutes one of the elements of water, of which it forms one-ninth, and oxygen eight-ninths. An inflammable, colorless gas, of extreme lightness; specific gravity 0.0692; that of water being 1.

Hydromagnesite—A mineral, supposed to be found in the serpentines on the peninsula of San Francisco, Cal. [*H. G. Hanks.*]

Hydrozincite—(Marionite)—Earthy Calamine, the silicate of zinc.

Idocrase—Vesuvian of Werner, Vesuvianite; consisting of alumina, lime and silica. *Cyprine* is the name of a rose-red variety.

Idrialine, or **Idrialite**—(See Petroleum)—A bituminous substance obtained from the quicksilver mines of Idria.

Ilmenite—(See Menaccanite)—Titanic Iron. A black metallic mineral, consisting of iron, oxygen and titanium.

Indicolite—Tourmaline of an indigo-blue color.

Indium—Symbol, *In.*

Iodine—A grayish or bluish-black solid, metallic luster, resembling plumbago; occurring in scales or crystals; exists in many marine plants and animals, in mineral waters, and in a few minerals, notably with nitrate of soda and salt.

Iolite—(Pinite)—A mineral having a glassy appearance, remarkable for presenting a blue or violet-blue color in one direction, and, at right angles with this direction, a yellowish-gray or brownish color. It consists of alumina, magnesia and silica, with some oxide of iron.

Iridium—One of the metallic elements, having a density of from 19.3 to 21.12, thus being the heaviest of known substances. In its native state is alloyed with osmium or platinum. A specimen from California gave the following analysis: Iridium 53.50, Osmium 43.40, Rhodium 2.60, Ruthenium 0.50=100.

Iridosmine or **Iridosmium**—The native compound of Iridium and Osmium; found in flattened metallic grains of extreme hardness.

Irite—A black mineral, shining luster, and magnetic; consisting chiefly of oxides of chromium, iridium, iron and osmium.

Iron—One of the metallic elements having the chemical equivalent 28, and density of about 7.8. It is monometric in crystallization, and of a white color when pure. It is hard, very malleable when hot, welding easily at a high temperature, and oxidises under moisture. The varieties are: **Arsenical Iron**—(See Löllingite. **Bog Iron**—(See Limonite.) **Cast-Iron** or **Pig Iron**, a compound of carbon and iron, brittle, and harder than pure iron. **Magnetic Iron** or **Magnetite**, an oxide iron containing three parts of iron to four of oxygen, and one of the most common of its ores, having generally an octahedral crystallization; some specimens having magnetic polarity, are called *Loadstone—Specular iron*, see *Hematite*. **Wrought-Iron**, the purest form of iron known in the arts; possesses great malleability and ductility; is soft, very tenacious, and at a high temperature may be welded.

Itaberite or **Itabirite**—A variety of Hematite, being a granular, slaty rock, consisting of specular or magnetic iron and quartz.

Itacolumite—A laminated, granular quartz rock, often occurring in regions where the diamond is found. Flexible Sandstone.

Jamesonite—Sulphide of antimony, iron, copper, lead and zinc. A steel-gray ore of lead and antimony. Gray Antimony Ore.

Jasper—An opaque, impure variety of quartz, of red, yellow and other dull colors. It breaks with a smooth surface, and admits of a high polish.

Jet—A variety of lignite, of a very compact texture, and velvet black color.

Kaolin or **Kaoline, Kaolinite**—A variety of clay used for making porcelain, consisting of decomposed mineral feldspar.

Kirwanite—A native silicate of iron, lime and alumina, found in basalt on the north-east coast of Ireland.

Kyanite—Consisting of alumina and silica; occurs usually in long, thin, blade-like crystals, of a clear blue or bluish-white color.

Labradorite—Labrador Spar; a beautiful variety of opalescent feldspar, from Labrador.

Lanthanium or **Lanthanum**—A metal occurring with cerium, and so called because its properties were concealed by those of the latter metal. Symbol, *La.*

Lead—Anglesite, Cerusite, Galena, Leadhillite. A metal of a dull white color, with a cast of blue. It is the least elastic and sonorous of all the metals, and at the same time it is soft and easily fusible. Its specific gravity, when pure, is 11.445; it is found native in small masses, but generally mineralized by sulphur and other substances.

Lenzinite—Hydrous silicate of alumina, a mineral of a clear brown color.

Lepidolite—A species of mica, presenting a lilac or rose-violet color.

Leucopyrite—White Pyrites; a mineral of a color between white and steel-gray, with a metallic luster; composition, Arsenic and Iron.

Lignite—Mineral Coal, retaining the texture of the wood from which it was formed. See Coal.

Limestone—Consisting chiefly of carbonate of lime, from which lime is obtained by the expulsion of its carbonic acid.

Limonite—Bog-Ore (see Iron). This is a hydrous sesquioxide of iron. found sometimes compact and fibrous, at others earthy and dull. When pure, the composition is: Sesquioxide of Iron 85.6, Water 14.4=100. Equivalent in metallic iron, 59.3 per cent.

Linnæite—Siegenite, cobalt pyrites.

Lithium—One of the alkaline metals, so-called because obtained from a mineral. It is the lightest metal known; specific gravity 0.59; atomic weight 7.

Lithomarge—A fine-grained hydrous silicate of alumina, probably sedimentary. It contains generally magnesia and lime.

Loadstone—A piece of magnetic iron ore possessing polarity like a magnetic needle: (See Iron—*Magnetic*).

Lollingite—Arsenical iron; known to be found at Paris, Me. [J. C. Smock].

Lucullite—A variety of black limestone, used for ornamental purposes.

Macle—Andalusite, Chiastolite, the crystals of which present a tessellated appearance when cut transversely.

Magnesite—Silicate of Magnesia, containing a large quantity of water; also Carbonate of Magnesia, composed of: Magnesia 47.6, Carbonic Acid 52.4=100.

Magnesium—The undecomposable metallic base of magnesia.

Magnetite—Magnetic iron ore. Composition: Protoxide of iron 31.03, Sesquioxide of Iron 68.97=100. Equivalent to: Iron 72.4, Oxygen 27.6=100.

Malachite—Native green Carbonate of Copper, Mountain Green. Composition: Protoxide of Copper 71.9, Carbonic Acid 19.9, Water 8.2=100.

Manganese—A metal of a dusky white or whitish-gray color, very hard and difficult to fuse. Sybol *Mn.*, chemical equivalent 27.6.

Manganite—One of the ores of Manganese; called also gray manganese ore.

Marble—Any species of calcareous stone or mineral of a compact texture; see Calcite.

Marcasite—Sulphide of Iron, White Pyrites; often containing a small proportion of arsenic.

Mariposite—A mineral of an apple-green color, found with quartz, on the Mariposa Estate, California; referred by Dana to Fuchsite.

Marl or **Marlite**—A mixed earthy substance, consisting of carbonate of lime, clay, and silicious sand, in very variable proportions; see Greensand.

Marmatite—A black mineral, consisting of the sulphurets of zinc and iron; black blende.

Marmolite—A variety of serpentine, usually of a pale-green color, capable of being split into thin, brittle laminæ.

Mascagnin—Native sulphate of Ammonia, found in volcanic districts.

Massicot—Protoxide of lead, or yellow oxide of lead, which has not been fused. When melted and allowed to crystallize, forms Litharge.

Meadow-Ore—Conchoidal bog-iron ore. (See Iron).

Melaconite—Black Copper, Black Oxide of Copper; a rare mineral in California, occurs with malachite and bornite, contains granules of metallic copper the size of birdshot.

Menaccanite—Ilmenite, Titanic iron. A black or steel-gray mineral, consisting chiefly of the titanate of iron.
Mengite—A black mineral, occurring in small crystals in granite veins in the Ilmen mountains, and consisting of zirconia, peroxide of iron and titanic acid.
Mercury—Cinnabar, Quicksilver. A metal, white like silver, liquid at common temperatures, congealing at 40° below zero, Fahr.; specific gravity 13.6.
Metacinnabarite—Is a black sulphide of mercury, resembles cinnabar in composition; a rare metal. [*H. G. Hanks*].
Mesotype—A zeolitic mineral, occurring in slender crystals, and delicate, radiated concretions, and consisting of the hydrated silicate of alumina and soda.
Meteoric Iron—Is of cosmical origin, having fallen to the earth from space. Specimens have been found at different times, varying from a few inches to many feet in thickness, of every conceivable shape. Composition principally iron and nickel; but have also been found to contain (in variable quantities) Cobalt, Carbon in combination, Graphite, Silica, Phosphorus and Sulphur.
Miargyrite—A mineral of an iron-black color, and very sectile, consisting principally of sulphur, antimony and silver.
Mica—Isinglass, Muscovite, Muscovy Glass, Phlogopite, etc. It is an essential constituent of granite, gneiss and mica slate; capable of being cleaved into elastic plates of extreme thinness. It occurs in various colors, and three or four varieties.
Michaelite—A white, pearly, fibrous variety of opal.
Millerite—Sulphide of Nickel. A rare mineral of a brass-yellow color, resembling Chalcopyrite; known to have been found near Cisco, Cal. [*Hanks*].
Mimetene—The mineral arseniate of lead, occurring in pale yellow or brownish hexagonal crystals.
Mineral Coal—Anthracite, Ionite, Lignite, etc. See Coal.
Molybdena or **Molybdenite**—Sulphide of Molybdenum. An ore of a dark lead color, occurring in flexible laminæ, like plumbago.
Molybdenum—A rare metal occurring variously in nature, as a sulphide; as molybdic acid; and with lead, as molydate of lead; obtained only in small, separate globules, in a blackish-brilliant mass, which are brittle, and extremely infusible.
Molybdite—Molybdic Acid, Molybdic Ochre. Found with Molybdenite and gold. [*Dana*].
Mundic—(See Pyrite)—Iron Pyrites, or Arsenical Pyrites.
Muriacite—A variety of anhydrite crystallized in broad lamellæ.
Nagyagite—Not abundant, but occurring with gold, pyrite and chalcopyrite; in numerous mines in Montana. [*W. Cross*].
Natrolite—(See Mesotype)—Soda Mesotype, Zeolite, occurring in implanted groups of glassy, acicular crystals, and in fibrous concretions.
Natron—Native carbonate of soda; see Trona.
Needle-Ore—Acicular ore of bismuth.
Needle-Spar—Aragonite. A mineral consisting chiefly of carbonate of lime.
Needle-Stone—Natrolite. A mineral of the zeolite family.
Newkirkite—A black, opaque mineral, with splendent metallic luster, crystallizing in small needles, and consisting of sequioxide of manganese, peroxide of iron and water.
Niccolite—Copper-nickel, associated with smaltite. [*John C. Smock*].
Nickel—(See also Millerite and Zaratite)—Rather a rare metal, generally found with iron and cobalt; except in meteorites, it is never found in the metallic state, being always combined with other elements, as antimony, arsenic, carbon, copper, oxygen, silicon, sulphur, etc. It is a silver-white, malleable, and ductile metal; specific gravity 8.28 when cast, and 8.666 when forged.
Niobium—See Columbium.
Niter or **Nitre**—Saltpeter, Nitrate of Potassa.
Nitratine—A mineral occurring in transparent crystals, usually of a white, sometimes of a reddish, gray, or lemon-yellow color; native nitrate of soda.
Nitrogen—A gaseous element, without taste, odor or color, forming nearly four-fifths of common air, and incapable of sustaining life; azote. Its specific gravity is 0.94; atomic weight 14.
Nontronite—A greenish-yellow or green mineral, consisting chiefly of the hydrous silicate of alumina.
Norium—(See Zircon)—A metal discovered in Zircon.
Novaculite—Oilstone; Razor-stone; Turkey-stone; Whet-slate; Whetstone. A variety of argillaceous slate, of which hones are made.
Obsidian—(See Orthoclase)—A kind of glass produced by volcanoes, usually of a black color, and opaque, except in thin splinters.
Ocher—(See Limonite)—A variety of fine clay containing iron; red and yellow are the common colors.
Omphazite—A foliated leek-green variety of pyroxene.
Onyx—(See Aragonite)—Chalcedony consisting of parallel layers of different

shades of color. The purest horn-colored onyx, with beautiful green jaspery zones, is called Jasp-onyx.

Opal—A mineral consisting of silex in what is called the soluble state, and usually a small quantity of water.

Orpiment—Yellow sulphide of arsenic, having a resinous taste. It occurs in nature as an ore of arsenic, and usually in combination with realga.

Orthoclase—Common Feldspar, including the subtranslucent varieties; a silicate of alumina and potash. Composition: Alumina 18.5, Potash 16.9, Silica 64.6=100.

Osmium—A brittle, gray-colored metal, found with platinum. Its oxide forms a volatile acid of an acrid, disagreeable odor. See also Iridium, with which it is invariably alloyed or associated.

Oxygen—A gaseous element, destitute, in its ordinary condition, of taste, color and smell, possessing strong chemical affinities. In certain conditions it is peculiarly active, and possesses both odor and taste, being then known as ozone. It serves to support life, and though heavier than air, forms about 22 per cent. of the atmosphere. By composition with hydrogen, it forms water.

Palladium—A metal, found in very small grains, of a steel-gray color, and fibrous structure, in auriferous and platiniferous sand. It is infusible by ordinary heat, and when native, is alloyed with a little platinum and iridium.

Pectolite—A grayish or whitish mineral, occurring in aggregating crystals of a silky luster, and arranged in stellar or radiated forms, or in fibrous masses. It consists of the hydrous silicate of alumina, lime and soda.

Pelopium—Symbol, Pe.

Peliom—A variety of Iolite, of a smoky-blue color.

Petroleum—Maltha, Rock Oil, a liquid, inflammable, bituminous substance, exuding from the earth and collected on the surface of the water in wells and fountains; it is essentially composed of carbon and hydrogen; see Asphaltum.

Petzite—Hessite, a telluride of silver and gold; the latter metal replacing part of the silver. Composition: Tellurium 35.40, Silver 40.60, Gold 24.80=100.80.

Phacolite—A mineral consisting of the hydrous silicate of alumina, lime and soda; a variety of chabasite.

Pharmacolite—A native hydrous arseniate of lime, white or grayish color, vitreous luster, found with ores of cobalt and silver.

Phenacite—A mineral consisting principally of silica and glucina, like quartz.

Phœnicochroite—Subsesquichromate of lead, occasionally met with in other lead ores, in Arizona. [*E. Stahl*].

Phonolite—Clink-stone, a compact, feldspathic, volcanic rock.

Phosgene or **Phosgenite**—Light Producer, Chloro-Carbonate of lead; straw-colored, acicular interlaced crystals in cavities.

Phosphorus—An elementary substance, of a yellowish color, and semi-transparent, resembling fine wax. Phosphorus acid is formed by a combination of phosphorus with oxygen, in the proportion of two equivalents of phosphorus to three of oxygen.

Photizite—A mineral consisting of a mixture of rhodonite and carbonate of manganese.

Phyllite—A mineral consisting chiefly of the hydrous silicate of alumina, iron and manganese, occurring in thin scales or leaves.

Pyrrhotite—Magnetic pyrites. [*Blake*].

Picotite—Chrome Spinel, occurs in the basalts of Mt. Shasta, Cal.

Picrolite—A fibrous variety of serpentine; see Serpentine.

Picrophyllite—A species of serpentine occurring in dark-green, foliated masses.

Picrosmine—A mineral, consisting chiefly of silicate of magnesia, and having a bitter, argillaceous odor when moistened.

Pimelite—An apple-green mineral, having a greasy feel, consisting chiefly of the hydrous silicate of alumina, iron, magnesia and nickel.

Pitch—An igneous rock of semi-glassy nature, having a luster like pitch, and related to obsidian.

Pitchblende—An ore of uranium, black or brownish color, and semi-metallic luster.

Plagionite—A sulphuret of lead and antimony, of a blackish lead-gray color, and metallic luster.

Platinum—(Platiniridium, Iridium)—A metal of the color of silver, but less bright, harder than iron, resists the action of acids, very ductile and capable of being rolled into thin plates; specific gravity (native) 16.00, (rolled) 22.69; is the least expansible, and with the exception of Iridium, the heaviest of known substances. It is *now* found to be fusible under the oxyhydrogen blowpipe. Analysis finds it generally to be alloyed with copper, gold, iridium, iron, osmium, palladium, rhodium, sand, etc.

Polybasite—A sulphide of many bases, viz: Antimony, arsenic, copper, iron, silver and zinc.

Polyhalite—A mineral, brick-red color, being tinged with iron, of a fibrous structure, consisting chiefly of the sulphate of lime, magnesia and soda.
Polymignite—A black, opaque mineral, having a brilliant, almost metallic luster, containing cerium, lime, manganese, oxides of iron, titanic acid, yttria and zirconia, and traces of magnesia, oxide of tin, potash and silica.
Potassium—A lustrous, bluish-white metal, having a strong affinity for oxygen, with which it forms potassa. Atomic weight 39, and lighter than water.
Priceite—Pandermite; see Colemanite.
Proustite—Light Ruby Silver Ore, arsenical sulphide of silver, found with galena, pyrite, pyrargyrite and quartz.
Psilomelane—Manganese Ore, containing baryta, oxide of manganese and water; dark color nearly steel-gray, and occurring in smooth, botryoidal forms, and massive.
Pumice or **Pumice-Stone**—(Lava)—A substance ejected from volcanoes, of various colors, as gray, white, reddish-brown, or black; hard, rough and porous; and so light as to float on water. It is supposed to be produced by the disengagement of gas, within the lava, while in a liquid or plastic state.
Pyrargyrite—Dark Ruby Silver, Antimonial Sulphide of Silver.
Pyrites—Sulphuret of Iron, Mundic, consisting of sulphur with cobalt, copper, iron or nickel, presenting a white or yellowish metallic luster. Composition: Sulphur 53.3, Iron 46.7=100.
Pyrochlore—A mineral usually of a yellowish or brownish color, consisting chiefly of columbic acid, lime, and protoxide of cerium, and sometimes titanic acid with, or in place of, the columbic acid.
Pyrolusite—Binoxide of manganese, color and streak black; it is brittle and opaque. Composition: Manganese 63.3, Oxygen 36.7=100.
Pyromorphite—The mineral phosphate of lead, occurring in bright-green and brown hexagonal crystals and masses.
Pyrophyllite—The hydrous silicate of alumina, of a white or greenish color and pearly luster.
Pyrrhite—An orange-yellow mineral, vitrious luster, consisting of the columbate of zirconia, colored, apparently, by oxides of iron, manganese and uranium.
Pyroxene—A silicate of different bases; the varieties of which are known as augite, diallage, diopside, hypersthene, omphazite, sahlite, smaragdite, etc. It occurs crystallized in oblique prismatic forms, and also massive, llamellar, granular, and fibrous; color green, but sometimes white or black.
Quartz—It is a binoxide of silicon, the elements being combined as follows: Oxygen 53.33, Silicon 46.67=100. Quartz is one of the most abundant of minerals, occurs in every variety of color and form; is colorless when pure, otherwise black, blue, brown, green, red, yellow, and variegated. The varieties, from crystallized to massive, are known by many names, among which are Agate, Amethyst, Aventurine, Bloodstone, Brazilian Pebble, Buhr Stone, Cairngorm, Carnelian, Cat's-Eye, Chrysoprase, False Topaz, Heliotrope, Jasper, Mocha Stone, Onyx, Prase, Quartz, Quartzite, Rock Crystal, Sardonyx, Siderite.
Quicksilver—(Mercury)—The ore of this mineral is of a bright-red color, the streak scarlet; and as *Cinnabar* (sulphide of mercury) has a specific gravity=8.99. Composition: Mercury 86.2, Sulphur 13.8=100; see Mercury.
Realgar—Sulphide of Arsenic. A mineral, of a bright red to orange color. Composition: Sulphur 29.9, Arsenic 70.1=100.
Remolinite—A mineral usually of a bright-green color, consisting of oxide of copper, chloride of copper, and water.
Retinalite—(See Serpentine)—A translucent variety of serpentine, of a honey-yellow or greenish-yellow color, having a resinous appearance.
Rhodium—A metal associated with platinum, of a white color and metallic luster, extremely hard and brittle, and has a specific gravity of about 11. It requires the strongest heat that can be produced by a wind furnace for its fusion.
Rhodocrosite—Carbonate of Manganese.
Rhodonite—Manganese Spar, or silicate of manganese.
Rock Soap—This is a mineral resembling halloysite, and mordenite, but believed to be a mechanical mixture of two or more minerals. No two analyses agree as to its composition; it takes the place of certain soaps.
Roscoelite—A very rare mineral found in Eldorado County, California; the analysis by Prof. H. E. Roscoe, of Manchester, England, is as follows: Alumina 12.84, Lime .61, Magnesia 2.01, Oxide of Manganese (Mn. 3. O. 4) 1.10 Potash 8.56, Sesquioxide of Iron 1.13, Silica 41.25, Soda .82, Vanadic Acid (V 2; O. 5) 28.60, Water combined 1.08, Moisture 2.27=100.27.
Rubellite—A red variety of tourmaline, varying in color from a pale rose-red to a deep ruby.
Rubicelle—A variety of ruby of a reddish color, from Brazil.
Rubidium—An alkiline metal first found in mineral waters; so-called from exhibiting dark red lines in the spectrum analysis, by means of which it was discovered. Symbol, *Rb*.

Ruthenium—A metal extracted from the ore of platinum. It is of a gray color, very hard and brittle; specific gravity 8.6; symbol, *Ru*.

Rutile—Titanic Acid; an ore of titanium, of a reddish-brown color, sometimes passing into red. It occurs usually in prismatic crystals, sometimes massive.

Salt—Chloride of Sodium, Halite, Rock Salt; the analysis of the average common salt gathered from the desert basins of the Pacific Coast, and of rock salt mined, is as follows: Chloride of Sodium 97.76, Sulphate of Sodium .70, Chloride of Iodine .27, Moisture .96, Insoluble matter .20=99.89.

Sandstone—A rock made of sand more or less firmly united. *Argillaceous Sandstone,* contains much clay; *Granitic Sandstone,* consists of granitic sand; *Silicious Sandstone,* consists mainly of quartz sand; but if very hard, it is often called Grit.

Saponite—Rock Soap; see Rock Soap.

Sapphire—Pure crystallized alumina; occurs in hexagonal crystals, and also in grains and massive; color blue.

Sarcolite—A variety of analcime from Vesuvius; applied also to a variety of chabasite, and to the mineral humboldtite.

Sard—Carnelian. A variety of chalcedony, of a rich brownish-red color, but which, when held between the eye and the light, appears of a deep blood-red.

Sassolite or **Sassoline**—Native Boracic Acid; occurs in the craters of extinct volcanoes, and as a saline incrustation on the borders of mineral hot springs. Composition: Boracic Acid 56.45, Water 43.55=100.

Scheeletine—A mineral of a green, yellowish, brown or red color, and resinous luster, consisting chiefly of tungstic acid and oxide of lead; tungstate of lead.

Scheelite—(See Cuproscheelite)—Tungstate of lime, a calcareous ore of tungsten, of a white or pale-yellowish color. Composition: Tungstic Acid 80.6, Lime 19.4=100.

Scheererite—A resinous, inflammable substance, occurring in loosely aggregated crystalline grains and folia, or in minute acicular crystals in small cavities in coal, and consisting of carbon and hydrogen.

Schorl—Black Tourmaline; see Tourmaline.

Schorlite—A variety of Topaz; a mineral of a greenish-white, and sometimes yellowish color.

Scolecite—Lime Mesotype; hydrated silicate of alumina and lime.

Scorodite—A native compound of arsenic acid and oxide of iron, having a leek-green or brownish color.

Selenite—Gypsum; a variety of sulphate of lime or gypsum, occurring in transparent crystals, or crystalline masses.

Selenium—An elementary substance, allied to sulphur, having a dark-brown color, with a metallic luster. It vaporizes at 650° Fahr.

Sepiolite—Meerschaum, Hydrous Silicate of Magnesia.

Serpentine—Chryotile, Picrolite, Retinalite. A mineral or rock consisting chiefly of the hydrous silicate of magnesia, and usually of an obscure-green color, spotted or mottled in appearance, from the presence of chromic iron. The translucent varieties of rich oil-green shades, usually dark, but sometimes pale, are called *precious* or *noble serpentine.*

Siderite—Carbonate of Iron, Spathic Iron; a hydrous arseniate of iron; cube ore: an indigo blue variety of quartz. Composition: Carbonic Acid 37.9, Protoxide of Iron 62.1=100.

Silicon—A dark-brown elementary substance, destitute of metallic luster, and a non-conductor of electricity. It is the base of silex or silica.

Silver—A soft, white, metallic element, very malleable and ductile, and capable of a high polish. It occurs in nature and also in combination with sulphur, arsenic, etc., and with ores of lead, copper and gold. Pure silver melts at 1860° Fahr.; atomic weight 108; specific gravity 10.47. The following is a list of the silver minerals, with the percentage of silver in each. Those marked with an asterisk have been found in California:

Rittingerite .... —	Eucairite...........43.1	*Embolite......61.07, 71.94
*Galenite, variable..	Iodyrite.............46.0	Naumannite........73.2
Styloptypite........ 8.0	*Stromeyrite 53.1	*Cerargyrite.........75.3
*Sylvanite.......3.9, 14.68	Bromyrite..........57.4	*Polybasite..........75.5
*Tetrahedrite........ —	*Pyrargyrite.........59.8	Dyscrasite..........78.0
Freieslebenite......24.3	Pyrostilpnite 62.3	Chilenite 86.2
Brogniardite........26.1	*Hessite..............62.8	*Argentite 87.1
Freibergite.....3.9, 31.29	Xanthoconite..... 64.0	*Native Silver—nearly pure.
Sternbergite........33.2	*Proustite 64.67	
Miargyrite..........36.0	*Stephanite 68.5	

Skolopsite—A mineral of a grayish-white or reddish-gray color, consisting chiefly of alumina, lime, silica and soda.

Skutterudite—A mineral of a bright metallic luster, sometimes iridescent, of a color between tin-white and pale lead-gray, consisting chiefly of arsenic and cobalt.

Slate—The slates are silicious sedimentary rocks; specific gravity from 26.72 to 27.84; and a cubic foot weighs from 167 to 180 lbs.; both slate and shale are, no doubt, sedimentary mud or silt, which, from great age, have become indurated, and for the most part were formed at the bottom of the sea. The fossils contained in them are conclusive evidence of this.

Smaltine or **Smaltite**—Gray cobalt ore; a tin-white or gray mineral, consisting of arsenic and cobalt, or arsenic and nickel, or sometimes all three combined with iron.

Smectite—A hydrous silicate of alumina, of a greenish color, which in certain states of humidity appears transparent and almost gelatinous.

Smithsonite—Carbonate of zinc; occurs with cerusite, in Inyo County, Cal.

Soda Alum—A mineral consisting of sulphate of alumina, sulphate of soda and water.

Soapstone—Steatite; see Talc.

Sodalite—A mineral occurring usually in small bluish dodecahedrons, and containing a large proportion of soda, with silica, alumina and hydrochloric acid.

Soda Niter—Nitrate of soda. Composition: Nitric Acid 63.5, Soda 36,5=100.

Sodium—A yellowish-white metallic element, soft like wax, and lighter than water; specific gravity, 97.

Spalerite—Blende, Zinc Blende, Black Jack, Sulphuret, of zinc. A mineral of a black, brown, green, or yellow color; streak white; transparent, opaque; specific gravity 3.9 to 4. Composition: Sulphur 33, Zinc 67=100.

Sphene—Titanite. A mineral composed of silica, titanic acid and lime. Its colors are dull yellow, green, gray, brown and black; found usually in thin wedge-shaped crystals.

Spherosiderite—Clay Ironstone; Nodular Iron Ore; Carbonate of iron in spheroidal masses, occurring in trap.

Spherulite—A variety of obsidian or pearl-stone, found in rounded grains.

Spragide—Earth of Lemnos, Lemnian Earth. A species of ocherous clay which falls to pieces in water, with the emission of many bubbles.

Spinelle—A mineral occurring in octahedrons, of great hardness, consisting of a sesquioxide and a protoxide in equal proportions, the former being usually alumina, but often partly sesquioxide of iron, the latter usually magnesia, but sometimes protoxide of iron, of zinc, etc.; colors black, blue, brown and green; when red or ruby, constitutes the gem *Spinal Ruby*.

Spodumene—(see Beryl)—A mineral consisting chiefly of alumina, silica, and the rare earth lithia.

Stalactite—A pendent cone or cylinder of carbonate of lime; see Calcite.

Stalagmite—A deposit of earthy calcareous matter, made by calcareous water dropping on the floors of caverns; see Calcite

Staurotide—A mineral crystalized in rhombic prisms, either single or intersecting each other, so as to form a cross. Its color is usually brown or black, generally opaque, or nearly so, and consists essentially of alumina, silica, and oxide of iron.

Steatite—(see Talc)—Soapstone; a soft magnesian rock having a soapy feel, presenting brown, grayish-green, and whitish shades of color; composition: Magnesia and Silica.

Stephanite—Black Silver, Brittle Silver Ore, Silver Glance.

Sternbergite—A foliated ore of silver, consisting of silver, iron, and sulphur.

Stibiconite—Antimony Ochre, Hydrous Oxide of Antimony, Partzite. The colors are yellow, pea-green to black; sp. gr., 3.8; composition: Teroxide of Antimony 47.65, Oxide of Copper 32.11, Oxide of Silver 6.12, Oxide of Lead 2.01, Oxide of Iron 2.33, Water 8.29=98.51.

Stibnite—Antimony Glance, Sulphide of Antimony; color or streak lead-gray, sometimes tarnished black or iridescent; sp. gr., 4.5 to 4.6; composition: Antimony 71.8, Sulphur 28.2=100.

Stromeyerite—Silver Copper Glance; a steel-gray ore of silver, consisting of sulphur, silver, and copper.

Strontia—An earth of a white color, resembling baryta in many of its properties. It is a compound of oxygen and the metal strontium, in the proportion of 8 of the former to 43.8 of the latter.

Strontianite—Carbonate of Strontia, occurring crystalized, fibrous, massive, and stellated in the form of a modified rhombic prism.

Strontium—A malleable metal, yellowish color, in properties resembling barium; symbol, *Sr.*; sp. gr., 2.54.

Succinite—Amber; a garnet of an amber color.

Sulphur—Brimstone; a simple mineral substance, of a yellowish color, brittle, insoluble in water, easily fusible, and inflammable; if cooled slowly crystallizes in needles; sp. gr., 2.07.

Sylvanite—Telluride of Gold; a mineral of steel-gray silver-white, or sometimes yellowish color, consisting of native tellurium with a considerable proportion of gold and silver.

Talc—French Chalk, Steatite, Soapstone; this is a soft mineral, generally foliated, except where it occurs in rocky masses as soapstone, when it is granular or crypto-crystalline. When pure it is of a green, white, or yellowish color, with a greasy or soapy feel. H.=1-2.5. Sp. gr.=2.55-2.78.

Tellurium—See also Altaite, Calaverite, Hessite, Petzite and Tetradymite. Tellurium is a white metal, brittle, and easily fusible. Its equivalent or combining weight is 64.2 (old system, 128.4 by the new). Symbol, *Te.* Tellurium, as far as known, is found only in ten rare minerals, as follows (the figures showing the percentage of tellurium in each): Altaite, combined with lead 38.2; Calaverite, combined with gold and silver 56.0; Hessite, combined with silver 37.2; Joseite, combined with bismuth, selenium and sulphur 15.93; Nagyagite, combined with copper, gold, lead, silver and sulphur 30.52; Petzite, a variety of hessite (No. 3)—; Sylvanite, combined with antimony, gold, lead and silver 44.0 to 60.0; Tellurium, native, nearly pure; Tetradymite, combined with bismuth and silver 33.0 to 48.0; Tellurite, doubtful.

Tephroite—A silicate of manganese of an ash-gray color, occurring both massive and granular.

Terbium—Symbol, *Tb.* See Gadinolite.

Tetradymite—Bismuth, with Tellurium. Telluride of bismuth.

Tetrahedrite—Fahlerz, Gray Copper. This mineral is a double sulphide of copper and antimony, of which there are numerous varieties.

Thallium—An alkaline metal, closely resembling lead in color, density, and softness, but in its chemical relations similar to the alkali-metals potassium and sodium.

Thenardite—Anhydrous Sulphate of Soda; composition: Soda 56.3, Sulphuric Acid 43.7=100.

Thomsonite—A mineral of the zeolite family, occurring generally in masses of a radiated structure, and glassy or vitreous luster. It consists of silica, alumina and lime, with some soda and water.

Thorite—A massive and compact mineral, resembling gadolinite. It contains 58 per cent. of the rare earth thoria, combined with silica.

Thorium—A heavy gray metal, which, when heated in the air, takes fire and burns with great brilliancy, being then converted into thoria.

Thrombolite—An opaque amorphous mineral of a vitreous luster, and of an emerald or dark-green color, consisting chiefly of phosphoric acid, oxide of copper and water.

Thuringite—A tough mineral of an olive-green color, pearly luster and argillaceous odor, consisting chiefly of silica, protoxide of iron, peroxide of iron, alumina and water.

Tiemannite—Selenide of Mercury.

Tin—Cassiterite. A white, soft, non-elastic metal, very malleable, fuses at 442° Fahr., and has a specific gravity of 7.3; see Cassiterite

Tincal—(See Borax)—Crude Borax as it is imported from the East Indies, in yellow, greasy crystals.

Titanite or **Sphene**—Titaniferous Iron, found in iron sand; sphene is found in small hair form crystals; see Sphene.

Titanium—A metal of a deep-blue color; it occurs in different states of oxidation or intermixture, in various parts of the world. The ores of this metal are called: *Iserine, Menachanite, Nigrine, Octahedrite, Rutile* and *Sphene.*

Topaz—A mineral occurring in rhombic prisms, generally yellowish and pellucid, also colorless, and of greenish, bluish or brownish shades; sometimes massive and opaque, and consisting of silica, alumina and fluoric acid. It is highly valued as a gem.

Topazolite—A variety of precious garnet, of a topaz-yellow color, or an olive-green.

Tourmaline—A mineral almost invariably found crystallized, of all colors, from opaque black to nearly or quite transparent colorless. The usual colors are: *black* (Schorl), *red* (Rubellite), *blue* (Indicolite), *green* (Chrysolite), *honey-yellow* (Peridot), *colorless* (Achroite). All the tourmalines contain boracic acid from 3 to 10 per cent. Composition: Alumina 36.0, Binoxide of Manganese 6.14, Boracic Acid 6.49, Flourine 2.0, Lime 0.8, Magnesia 2.3, Potash 0.38, Sesquioxide of Iron 7.14, Silica 36.71, Soda 2.04=99.28.

Trap—A heavy, igneous rock, of a greenish-black or grayish color, consisting of an intimate mixture of feldspar and hornblende or pyroxine.

Triphyline—A mineral of a grayish-green or bluish color, consisting of the phosphates of iron, manganese and lithia.

Triplite—An imperfectly crystallized mineral, of a dark-brown color, consisting of phosphoric acid and the oxides of manganese and iron.

Trona—Sesquicarbonate of soda. This mineral is found with gay-lussite, salt, thenardite and tincal, in many different localities on the Pacific Coast. Composition: Carbonic Acid 40.2, Soda 37.8, Water 22 0=100.

Tufa—A soft or porous stone formed by depositions from water, usually calcareous.

Tungston—A metal of a grayish-white color, considerable luster, brittle, nearly as hard as steel, and fused with extreme difficulty; specific gravity near 17.6; also called Wolframium.

Turpeth or **Turbith Mineral**—Yellow Sulphate of Mercury. A yellow salt composed of 3 equivalents of the protoxide of mercury and 1 equivalent of sulphuric acid. It is not found in nature.

Turquois—A mineral of a peculiar bluish-green color, occurring in reniform masses, with a botryoidal surface; susceptible of a high polish, and when highly colored, much esteemed as a gem; Calaite.

Tyrolite—A translucent, very sectile mineral, of a green color, and pearly or vitreous luster, consisting chiefly of arsenic acid, oxide of copper, carbonate of lime and water.

Ulexite—Borate of Lime, Boronatrocalcite, Cotton Balls, Natroborocalcite, Sheet Cotton, Tinkalzit, Tiza, etc. This curious mineral was first found in the Niter beds of Peru, in small quantities. It is a natural hydrated borate of lime and soda. Analysis by Ulex, is as follows: Boracic Acid 49.5, Lime 15.9, Soda 8.8, Water 25.8=100.

Ullmannite—A brittle mineral of a steel-gray color and metallic luster, consisting of antimony, arsenic, nickel and silver.

Uraninite—Pitchblende, an ore of uranium; see Pitchblende.

Uranite—An ore of uranium, of a bright-green or yellow color, and foliated like mica. The green variety consists of oxide of uranium, phosphoric acid, and copper, and is called chalcolite or copper uranite.

Uranium—A metal discovered in the mineral called pitchblende, in which it exists as an oxide, with oxide of iron, and some arsenic, cobalt, lead, sulphur and zinc. It occurs also in uranite, and uran-ochre, and a few other minerals. Color reddish-brown; luster metallic; form crystalline.

Vanadinite—The mineral vanadate of lead, occurring in yellowish and brownish hexagonal crystals.

Vanadium—A metal having a white color, and a strong metallic luster, extremely brittle, resembling silver, but more like molybdenum.

Variscite—An apple-green mineral occurring in reniform masses, and consisting chiefly of alumina, phosphoric acid and water.

Vauquelinite—Chromate of copper and lead, of various shades of green.

Vermiculite—A mineral having a granular, scaly structure, and resembling steatite in appearance; consisting chiefly of alumina, magnesia and silica.

Vesuvianite—Idocrase. Is a silicate of alumina, iron and lime.

Vivianite—A phosphate of iron of various shades of blue and green; the mineral is that variety known as blue iron earth or native Prussian blue. Composition: Phosphoric Acid 28.3, Protoxide of Iron 43.0. Water 28.7=100.

Volborthite—Vanadate of Copper. A mineral of a green or gray color, consisting chiefly of vanadic acid, oxide of copper, lime, and water.

Volgerite—Antimony Ocher, associated with other antimony ores.

Voltzite—A rose-red, yellowish or brownish mineral, occurring in implanted spherical globules, and consisting chiefly of sulphuret of zinc and oxide of zinc.

Vulpinite—A variety of anhydrite, containing some silica and presenting a grayish, white color and high luster.

Wad—Bog-manganese. An earthy oxide of manganese, or mixture of different oxides and water, with some oxide of iron, and often alumina, baryta, lime, or silica, and including several varieties; sometimes applied to Plumbago or Black Lead.

Wagnerite—A phosphate of magnesia, resembling the Brazilian topaz.

Walchowite—A resinous substance occurring in yellow, translucent masses, often striped with brown; formerly called Retinite.

Warwickite—A dark-brown or black mineral, consisting chiefly of boracic acid, titanic acid, magnesia and oxide of iron.

Wheel-Ore—An opaque mineral of a steel-gray or black color, and metallic luster, consisting chiefly of antimony, copper, lead and sulphur.

Whewellite—A brittle, crystalline mineral, consisting chiefly of oxalate of lime.

Willemite—Anhydrous Silicate of Zinc. A mineral of a resinous luster and yellowish color, consisting chiefly of silicate of zinc.

Wolfram—Tungstate of Iron. An ore of tungsten; color brownish or grayish-black, and sub-metallic in luster. It occurs massive and crystallized, and in concentric, lamellar concretions.

Wulfenite—Molybdate of lead; occurring in small, perfect, tabular crystals, yellowish color, with a specific gravity of from 6 to 7

Xylotile—An opaque, glimmering, delicately fibrous mineral, of a light or dark wood-brown or sometimes green color, consisting of magnesia, sesquioxide of iron, silica and water.

Yttrocerite—A mineral of a violet-blue color, inclining to gray and white, or sometimes white or reddish-brown, It consists of lime, sesquioxide of cerium, yttria. and hydro-fluoric acid.

Yttrium—A very rare metal, texture scaly, color grayish-black, and luster perfectly metallic. Yttria, Phosphyttrite.

Yttrocolumbite—An ore of columbium and yttrium, in black, brown and yellow colors.

Zaratite—Emerald Nickel, Hydrate of Nickel, Hydrated Carbonate of Nickel. A rare mineral and ore that is never found in large quantities, generally as a thin coating or chromic iron and serpentine.

Zeolite—The name applies to a group of minerals which includes at least 20 species; the name is therefore indefinite. They are all hydrous silicates of alumina, and generally are found in lavas and amygdaloids

Zinc—See also Blende, Smithsonite, and Spalerite. A metal of rather rare occurrence, never found in nature, of a brilliant white color, with a shade of blue, and appearing as if composed of plates adhering together; it is not brittle, but less malleable than copper, lead, or tin. Sp. gr.=6.861; atomic weight 32.56 (by old, and 65 by the new method).

Zinc-blende—A native sulphuret of zinc, often containing some iron, occurring crystallized, massive, or in other forms, and of various colors, but usually yellowish, red, brown, or black. Blende.

Zinc-bloom—An opaque mineral, of a dull luster and white, grayish, or yellowish color, consisting chiefly of carbonic acid, oxide of zinc, and water.

Zincite—Red Oxide of Zinc, Red Zinc Ore. A brittle, translucent mineral, of a deep-red color, sometimes inclining to yellowish, and consisting chiefly of oxide of zinc, but containing also a small quantity of oxide of manganese.

Zinkenite—A steel-gray ore of antimony and lead.

Zircon—Jargon, Hyacinth, Silicate of Zirconia. A mineral containing the earth zirconia and silica, with 67 per cent. of the former to 33 per cent. of the latter; occurring in square prisms with pyramidal terminations of a brown or gray color, occasionally red, and often nearly transparent. A red variety is called Hyacinth.

Zirconium—A metal obtained from the minerals zircon and hyacinth. It is commonly obtained in the form of a black powder.

Zoisite—A grayish or whitish mineral, related to epidote.

Supplemental List of Some New Varieties of Minerals.

Agnesite—Carbonate of bismuth.
Agricolite—Silicate of bismuth.
Animikite—Antimonide of silver.
Argyrodite—Sulphide of silver and germanium.
Arsenargentite—Arsenide of silver.
Arsenstibite—Hydrous arsenate of antimony.
Barysil—Silicate of lead.
Belonesite—Molybdate of magnesium.
Cobaltomenite—Selenite of cobalt.
Coloradoite—Telluride of mercury.
Edisonite—Oxide of titanium.
Eggonite—Silicate of cadmium.
Ferrotellurite—Tellurate of iron.
Flinkite—Hydrous arsenate of manganese.
Hanksite—Sulphato-carbonate of sodium.
Horsfordite—Antimonide of copper.
Huntilite—Arsenide of silver.
Hydrargyrite—Oxide of mercury.
Krennerite—Telluride of gold, silver and copper.
Liskeardite—Hydrous arsenate of aluminum.
Manganosite—Protoxide of manganese.
Melanosiderite—Hydrous silicate of iron.
Metastibnite—Red sesquisulphide of antimony.
Molybdomenite—Selenite of lead.
Nitrobarite—Nitrate of barium.
Phosphuranylite—Hydrous phosphate of uranium.
Pseudobrookite—Titanate of iron.
Randite—Hydrous carbonate of calcium and uranium.
Redingtonite—Hydrous sulphate of chromium.
Reinite—Tungstate of iron.
Siderazot—Nitride of iron.
Sperrylite—Arsenide of platinum.
Sphaerocobaltite—Carbonate of cobalt.
Spodiosite—Fluo-phosphate of calcium.
Stutzite—Telluride of silver.
Tocornalite—Iodide of silver and mercury.
Xanthiosite—Arsenate of nickel.
Yttrialite—Silicate of yttrium and thorium.
And **297** other new species and varieties.

RADIUM.—Discovered, or re-named as a metal (or element), in 1903. Possesses so many startling properties that at present its composition is unknown. It contains three different kinds of rays; it has been transformed into *helium*; its temperature is slightly above that of the atmosphere; it emits heat without any sensible loss of weight.

Food Supply and Cost of Living, Including Intoxicants and Tobacco, in Principal Countries of the World.

Country.	Consumption of Food, **Pounds** per Inhabitant of:—							†Intoxicants	Tobacco.
	Butter, and Cheese.	* Coffee and Tea, **oz.**	Grain.	Meat.	Potatoes.	Salt.	Sugar.	Gallons.	Pounds.
Australasia......	20	127	350	**276**	305	36.5	**91**	2.20	2.83
Austria	7	28	460	61	560	14	18	2.80	2.73
Belgium..........	15	142	**590**	65	**1,050**	....	27	4.00	3.15
Canada	**22**	72	400	90	600	**40**	45	....	2.11
Denmark	**22**	140	560	64	410	25	22	5.00	2.24
France	8	66	540	77	570	20	20	**5.10**	2.05
Germany.........	8	78	550	64	1,020	17	18	3.08	3.00
Great Britain...	19	91	378	109	380	**40**	**75**	3.57	1.38
Italy	4	20	400	26	50	18	8	3.40	1.28
Netherlands.....	15	**240**	560	57	820	20	35	4.00	**6.92**
Norway	14	144	440	78	500	**40**	13	....	2.29
Portugal..........	3	18	500	45	40	17	12	3.00	1.75
Roumania.......	9	8	400	82	80	....	4	....	....
Russia	5	6	635	51	180	19	11	2.02	1.82
Servia	9	8	400	84	80	....	4	....	....
Spain...............	3	6	480	71	20	17	6	2.85	1.10
Sweden...........	11	112	560	62	500	28	22	....	1.87
Switzerland	11	110	440	62	140	....	26	....	3.24
United States ..	20	162	370	150	170	39	53	2.65	4.40

* Ounces of coffee and tea. † Reduced to gallons of proof spirit.

Annual Expenditure per Inhabitant in Principal States of Europe and U. S.

Country.	Amt. per capita.	Country.	Amt. per capita.	Country.	Amt. p'r capita.
Australasia..........	$212.38	Germany..........	$ 98.14	Russia	$ 49.13
Austria................	69.28	Great Britain...	144.72	Spain	76.04
Belgium	123.66	Italy	56.21	Sweden..............	99.36
Canada	111.43	Netherlands	101.55	Switzerland.......	87.60
Denmark	139.04	Norway............	92.46	United States....	159.66
France................	116.63	Portugal...........	54.87		

Ingredients of Ordinary Food Materials, such as meat, fish, eggs, potatoes, wheat, etc., consist of: *Refuse.*—As the bones of meat and fish, shells of shellfish, skin of potatoes, bran of wheat, etc. *Edible portion.*—As the flesh of meat and fish, the white and yelk of eggs, wheat flour, etc. The edible portion consists of *water* and *nutritive ingredients* or *nutrients.* The principal kinds of nutritive ingredients are *protein, fats, carbohydrates,* and *mineral matters.* The water, refuse, and salt of salted meat and fish are called non-nutrients. In comparing the values of different food materials for nourishment they are left out of account.

Familiar Examples of Compounds of each of the four principal classes of nutrients:—

Protein. *Proteids.—Albuminoids,* e. g., albumen (white of eggs); casein (curd) of milk; myosin, the basis of muscle (lean meat); gluten of wheat, etc. *Gelatinoids,* e. g., collagen of tendons; ossein of bones, which yield gelatin or glue, etc. Meats and fish contain very small quantities of so-called "extractives." They include kreatin and allied compounds, and are the chief ingredients of beef tea and meat extract. They contain nitrogen, and hence are commonly classed with protein.

Fats, e. g., fat of meat; fat (butter) of milk; olive oil; oil of corn, wheat, etc.

Carbohydrates, e. g., sugar, starch, cellulose (woody fiber), etc.

Mineral matters, e. g., phosphate of lime, sodium chloride (common salt), etc.

Ways in Which Food Is Used in the Body.—Protein forms tissue (muscle, tendon, etc., and fat) and serves as fuel. Fats form fatty tissue (not muscle, etc.) and serve as fuel. Carbohydrates are transformed into fat and serve as fuel. All yield energy in form of heat and muscular strength. In being themselves burned to yield energy the nutrients protect each other from being consumed. The protein and fats of body tissue are used like those of food. An important use of the carbohydrates and fats is to protect protein (muscle, etc.) from consumption. Food supplies the wants of the body in several ways. It either is used to form the tissues and fluids of the body, is used to repair the wastes of tissues, is stored in the body for future consumption, is consumed as fuel, its potential energy being transformed into heat or muscular energy, or other forms of energy required by the body, or, in being consumed, protects tissues or other food from consumption.

CANALS OF THE WORLD.

Depth of Canals in the United States.—Ogeechee Canal, Ga., 3 feet; Galveston and Brazos, Tex., 3½ feet; Black River, N. Y.; Hocking, Ohio; Ohio Canal; and Walhouding Branch, Ohio, each 4 feet; Des Moines Rapids; Morris, Pa., and N. J.; and Santa Fé, Fla., each 5 feet; Miami and Erie; and Susquehanna and Tidewater, Pa. and Md., each 5½ feet; Champlain, N. Y.; Chesapeake and Ohio, Md. and D. C.; Company's La.; Delaware and Hudson, N. Y. and Pa.; Delaware Division, Pa.; Dismal Swamp, Va. and N. C.; Ill. and Mich., Ill.; Lehigh Coal and Nav. Co., Pa.; Muscle Shoals and Elk River Shoals, Tenn.; and Pennsylvania, Pa., each 6 feet; Schuylkill Nav. Co., Pa., 6¼ feet; Cayuga and Seneca, N. Y.; Delaware and Raritan, N. J.; Erie, N. Y.; Ill. and Miss., Ill.; and Oswego, N. Y., each 7 feet; Albemarle and Chesapeake, Va. and N. C., 7½ feet; Chesapeake and Delaware, Md. and Del., 9 feet; Augusta, Ga., 11 feet; Welland, connects Lake Ontario and Lake Erie, 14 feet; Portage Lake and Lake Superior, Mich.; and Sturgeon Bay and Lake Mich., each 15 feet; Sault Ste. Marie, St. Mary's River, Mich., 18 feet; St. Mary's Falls, Mich., 21 feet.

The Harlem River Ship Canal, connecting the Hudson River and Long Island Sound, by way of Spuyten Duyvil Creek and Harlem River, opened for traffic June 17, 1895, and cost $2,700,000.

New York Canals.—The whole number of tons of freight carried upon the state canals during 1897 was 3,617,804 tons, as compared with 3,714,894 tons for 1896.

St. Mary's Falls Canal.—Gross tonnage for 1897, was 18,982,755 tons, against 16,239,061 tons in 1896, and 15,062,580 tons in 1895.

Baltic Canal.—Also called the "North Sea and Baltic," and "Kiel" Canal. The traffic from Apr. 1, 1897, to Mar. 31, 1898, was 23,108 vessels, with a net carrying capacity of 2,469,795 registered tons, against 19,960 ships and 1,848,458 tons in the previous working year.

Manchester Canal.—Cost about $77,000,000. The sea-going tonnage for six months ending June 30, 1898, was 979,992 tons, as compared with 783,280 tons during the corresponding period of 1897, while the barge traffic was 193,888 tons, against 173,930.

Suez Canal.—This canal was opened for traffic in 1869, the English Government acquiring by purchase, Nov. 25, 1875, shares to the amt. of £4,000,000, the present value of which is (Jan. 1, 1899) £24,435,000. The total length of the canal is 99 miles, with a width of 327 feet for 77 and 196 for the remaining 22 miles; the depth is 26 feet throughout. By an agreement signed Oct. 29, 1888, the canal was exempted from blockade, and vessels of all nations, whether armed or not, are to be allowed to pass through it in peace or war. It cost $102,750,000 to construct it. For the year 1895, the receipts were $15,147,184, received from 3,434 vessels, with a net tonnage of 8,448,383. In 1896, receipts $15,787,046; vessels passed, 3,409; net tonnage, 8,560,283. In 1897 receipts $14,129,122; vessels passed, 2,986; net tonnage, 7,899,374. For the first six months of 1898, the receipts were $8,636,920 in dues, from 1,792 ships, with 4,842,078 net tons.

Nicaragua Canal.—Projected to connect the Atlantic and Pacific Oceans, using the waters of Lake Nicaragua. The total distance from ocean to ocean, 169.4 miles; depth of canal, 30 feet; least width at bottom, 100 feet; time transit from ocean to ocean, 44 hours; length of Lake Nicaragua, 110 miles; average width, 40 miles; surface area, about 2,600 square miles; area of watershed of lake, about 8,000 square miles. Estimated cost of construction of this waterway by the Nicaragua Canal Commission was $125,000,000; time required for construction, 5 years. Distance from N. Y. to S. F., Cal., by water *via* Cape Horn, 14,549; by the Nicaragua Canal, the distance between the same points will be 4,907 miles, a saving of about 9,642 miles. Distance from N. Y. to the Pacific Ocean, *via* the Nicaragua Canal, 2,519 miles; to San Francisco *via* R. R., 3,250 miles; to San Diego, *via* R. R., 3,172 miles; to Tacoma, Wash., 3,209 miles; to Victoria, B. C., 3,619. Distance from N. Y. to Manila, P. I., *via* S. F., Cal., rail and water, 9,250 miles; *via* Nicaragua Canal, 11,746 miles; *via* Suez Canal, 11,565.

Panama Canal.—Length, 46⅓ miles; estimated time of transit, 14 hours. The canal is practically finished from Colon to Bujee, 14 miles; this, however, is the least expensive part. The great trouble is in passing through the Culebra Ridge. The width of the canal will be 124 feet at the top, and 72 feet at the bottom, except through the ridge, where it will be 78 feet at the top and 29 feet at the bottom, and 30 feet in depth. About $297,000,000 is estimated as having already been expended on the canal, resulting in the accomplishment of about 40 per cent of the entire amount of excavation that will be required. Time required for completion, about ten years.

CANALS (IN OPERATION) IN THE UNITED STATES,

CANALS BY STATES.	Points Connected.	Built. Enl'rgd	Length Miles.	No. locks	Cost Construction
Delaware.					
Chesapeake & Del. * †	Del. City—Chesapeake..	....	14.00	3	$ 3,730,230
Florida.					
Santa Fé *	Waldo—Melrose......	1877-1880	10.50	....	70,000
Georgia.					
Augusta Canal †	Savannah R.—Augusta..	1847.. ...	9.00	......	1,500,000
Ogeechee *	" "—Oge'ch'e R	1829-1840	16.00	5	407,818
Illinois.					
Ill. & Mich. Canal †	Chicago—La Salle..........	1836-1848	102.00	15	6,557,681
Louisiana.					
Carondalet C. & Nav. Co. ‡	N. Orleans—Bayou St. J.	1794.......	2.00	....	750,000
Company's Canal †	Miss R.—Lake Salvador.	1847.......	3.00	1	90,000
Harvey's Canal †	....	1830.......	5.75	3	150,000
Orleans Bank Canal ‖	N.Orleans—Ponchartr'n	1832-1835	6.50	. .....	1,000,000
Tagliaferro Canal †	Miss. R.—Bay. Baritaria	1880-1881	1.75	2	40,000
Maryland.					
Chesapeake & Ohio *	Wash., D. C.—Cumberl'd	1828-1850	179.50	75	11,290,327
Susquehanna & Tide-water* ‖	Pa.S.L.—Havre de Grace	1839......	15.00	....	. ...
Michigan.					
L. S. Ship-canal, R. & I. Co	L. Superior—Portage L..	1868-1873	2.12	....	3,925,300
St. Mary's Falls * †	St.Mary's F—S.Mary's R	1853-1855	1.02	1	3,500,000
New Jersey.					
Del. and Raritan * †	N.Brunsw'k—Bordent'n	1834-1838	44.00	14	4,735,353
" " " feeder	Bull's Island—Trenton. .	1838.......	22.00	1	....
Morris Canal & Banking Co.	Easton, Pa.—Jersey C'y	1825-1845	103.00	a 46	6,000,000
Pa. Neck Canal † b	Salem Creek—Del. R......	1800-1872	2.02	....	41,006
New York.					
Black River Canal & I Co	Rome—Carthage..........	1836-1861	85.50	110	3,224.779
Cayuga & Seneca *	Montezuma—C. & S. L's	1825-1855	24.77	11	1,520,542
Champlain Canal e	Whitehall—Waterford...	1817-1870	81.00	33	2,378,910
Del. & Hudson *	Honesd'le, Pa.—Rond'ut	1826-1828	c 83.00	d107	6,339,210
Erie Canal h	Albany—Buffalo......	1817-1862	365.48	72	51,609,200
Oneida R. Improvement	3 R's Point—Brewerton.	1839-1850	f 20.00	2	79,346
Oswego Canal	Syracuse—Oswego	1825-1862	18.00	18	3,077,429
North Carolina,					
Albemarle & Chesapeake (N. C. cut) g †	Canjock Bay—N. River.	1855.......	5.50	....	....
Fairfield C. & Turnpike Co	Allig'tr R—Mat'muskt L	1868.......	4.50	....	100,000
New Berne & Beaufort * †	Clubfoot Cr.—Newp'rt R	1880-1882	3.00	....	200,000
Ohio.					
Hocking Canal	Carroll—Nelsonville	1843.	42.00	26	947,670
Miami & Erie * h	Cincinnati—Toledo.........	1825-1835	284.25	93	7,144,234
Muskingum Improvement	Zanesville—Marietta.......	1840.......	f 75.00	12	1,628,028
Ohio Canal h	Cleveland— Portsmouth	1825-1835	323.00	150	4,695,202
Walhonding Branch	Rochester—Roscoe......	1843......	25.00	11	607,369
Oregon.					
Willamette T. & Locks Co. †	Oregon City....	1873.......	0.75	5	600,000
Pennsylvania.					
Delaware & Hudson *	(See New York)............	1826-1828	25.00	....	....
Delaware Division *	Easton—Bristol......	1830.......	60.00	33	2,433,350
Lehigh Coal & N. Co	Coalport—Easton............	1819-1821	48.00	57	3,000,006
Monongahela Nav. Co	Pittsburg—Geneva.......	1838-1844	f 85.00	6	1,115,452
Muncy Canal Co	Muncy—Penn. Canal......	....	0.75	....	7,077
Penn. Canal Co. i	Columbia—Duncan's Isl.	1826-1834	46.00	15	
" " " j	Clark's F'y—N'umberl'd	1828-1833	41.00	9	
" " " k	N'umberl'd—Wilkesb're	1830... ...	o 64.00	7	
" " " l	Junction—Huntingdon...	1827-1834	90.00	36	7,731,750
" " " m	N'umberl'd— Flem'gton	1828-1833	68.00	18	
" " " n	Clark's F'y—Millersburg	1838-1839	13.00	6	
Schuylkill Nav. Co	Mill Creek—Phila..........	1816-1826	58.18	71	12,580,461
Susquehanna & Tide-water *	Columbia—Md. St. Line.	1837-1840	p 30.00	43	4,930,705
Union Canal Co	Middletown—Reading....	1819-1827	84.64	93	5,907,850
Texas.					
Galveston & Brazos Nav.Co.†	Galveston—Brazos R......	1850-1851	8.00	....	340,000
Virginia.					
Albemarle & Chesapeake * †	Norfolk—Currituck...	1855-1860	q 8.44	1	1,641,363
Alexandria & Georgetown *	W.Wash.D. C.—Al'xnd'a	1830..	7.12	4	1,250,000
Dismal Swamp * †	Eliz'b'th R—Pasquot'nk	1794.......	28.00	7	1,151,000
Total			r2,695.04	1,224	170,028,636

* Canal Co.; † ship; ‡ old canal (ship); ‖ new canal (ship); ‖ see Pa.; a 23 inclined planes and 23 lift-locks; b Salem Creek Con. Meadow Co.; c exclusive of 25 miles in Pa.; d and 2 way-locks, 2 stop-locks and 2 guard-locks; e feeder and dam; f slack-water; g see Va.; h branches and feeders; i E. division; j Susquehanna division; k N. division; l Juniata division; m W. branch; n Wiconisco branch; o now extending to Nanticoke, 69 mi's; p exclusive of 15 m. in Md.; q exclusive of 5.50 m. in N. C.; r including 180 m. slack water.

ANCIENT FREEMASONRY

An Extract from a Lecture entitled, "Freemasonry in General," by the Rev. O. C Wheeler, D. D., LL. D., first delivered at Masonic Temple, Oakland, Cal., Feb. 21, 1882.

"Free Masonry has been the theme of thought, the object of envy, and the subject of persecution from remote ages.

Its friends have sought its origin, and watched its course. Its enemies have traduced its advocates, maligned its motives, and impeded its progress, until it seems to engage the attention of universal man. It has now reached a point where the man who throws light upon its true character and unrolls any portion of the endless scroll of its history, is as much a public benefactor as he who discovers a law of nature or develops a hidden science. Therefore, if my present effort shall in any measure increase the sum of your masonic knowledge, I shall not have 'labored in vain, nor spent my strength for naught.' For my ability to prepare this lecture, I am indebted to studies that have continued through more than twenty-five years, during which I have laid under contribution the works of such ancient authors as Sesostris, Misraim, Hermes, Plato, Zoroaster, Socrates, Pythagorus, Solon, Lycurgus, Alcibiades, Homer, Thales, Orpheus, Virgil, Hyppocrates, Pluche, Proctus, Heroditus, Claville, and Plutarch; and such modern ones as Rebolt, Strait, Macoy, Ussar, Wilder, Mackey, Wake, Westropp, Taylor, Pierson, Davies, King, Sanderson, Warburton, Oliver, Pike, Webb, La Plugeon, Zosismus, Pansanius, Knight, Rawlinson, Jablonski, Champolion, and others, and Hieroglyphics—to each and all of whom I make grateful acknowledgements. My method has been to read with care, make notes, full, free, and accurate; then compare, collate, and arrange data, from which to deduce facts and evolve principles—thus consolidating and digesting all accessible knowledge and learning on this subject. After all that, I have, in my own language, very seldom appropriating a phrase, or making a reference, written my discourse, and now give you what these numerous standard authors have taught me, together with my deductions therefrom. Should you ask me, 'Where did you find this or that fact, or idea,' I should probably not be able to tell you. Freemasonry, not only in the substance of its principles, but in its organized form and active labor, is older than any other institution now existing on earth. And that its honor is not inferior to its age, is attested by the fact that the princes and rulers, the highest and the noblest, the wisest and best men of every age, have been and still are proud to be able to say., 'I am a Freemason,' as the noble Roman ever was to say, 'I am a Roman citizen.' Nor was the latter ever a more sure protection from danger or potent guaranty of favor, than the former from remotest ages has been, now is, and to the end of time will be.

ANTIQUITY.—I have referred to the age of the institution of Freemasonry, as being superior to that of any other. The discovery of a key to the Egyptian Hieroglyphics on the 'Rosetta stone,' by Champolion, in the early part of the 19th century, has opened the past in such immensity as to confound the most learned Antiquarians, and to challenge the faith of the most credulous. Heroditus says, the secret institution of Isis—which the Hieroglyphics tell us was the real origin of Masonic mysteries—with its imposing ceremonies, made its appearance simultaneously with the organization of Egyptian society, and the birth of Egyptian civilization. Now as it takes about 100,000 years for Egypt—according to the teaching of her Hieroglyphics—to rise from primitive barbarism to the zenith of enlightened civilization and return to its first estate, and as Egypt, at the beginning of Bible history, had been twice to the pinnacle of learning and art, and was, for the third time at the depth of degradation, the sublime mysteries of Isis must have been, at that time, not less than 250,000 years old. With this state of facts before us, we can see how very possible was the account which has hitherto given our credence such a strain, viz: That the mysteries were carried to all the Oriental nations, from Egypt to India, by Brahma; to China and Japan by Buddah; to Persia, by Zoradhust; to Greece, by Metampus; to Crete, by Minos; to Messene, by Cancan; to Thebes, by Methapus; to Athens, by Erectheus; to Italy, by Palasgi; to Gaul and Britain by Gomer; to Mexico, by Vitzlipultzli; to Peru, by Manco Capac; and to Judea, by Hiram Abiff. The antiquity, therefore, is established, not only beyond doubt, but almost beyond belief. How strangely this contrasts with the strange conclusion of Prof. Moses Stuart, of Andover Theological Seminary, who, in the days of the great Anti-Masonic excitement, on account of his superiority as an Oriental scholar, was appointed to examine into and report upon the question of the age of the institution of Free-Masonry. After several months of profound investigation, he came forward, and looking over his spectacles 'officially reported' to his employers, "Gentlemen, I assure you that the institution of Free-Masonry has no claims to antiquity." (See next page.)

Brethren, that Key, on that **'Rosetta stone'** has, through the unlocking of the Egyptian Hieroglyphics, opened a door to, and given us a view of the past, so great that it was reckoned by tens of thousands of years, prior to the utmost stretch of Prof. Stewart's imaginings in the direction of antiquity. And the farther border of that incomprehensible vista, we trace the footsteps of our unequaled fraternity with all the distinctness of the most modern history.

INITIATORY DEGREE 25,000 YEARS B. C.—A brief description of some of the initiatory ceremonies practiced at and near the city of Memphis, (which was then the principal seat of the work) 25,000 years B. C., will not fail of interest. (The members of the 'Mystic Tie' will not need that I stop to explain, others present will not expect me to.) The candidate satisfied the craft that he was worthy. He then spent a week in a chamber of reflection, with a light diet and frequent ablutions to purify his blood. He then entered the pyramid in the night, descended the narrow way, without steps, on his hands and knees, until he passed through a large room, and into another, on the walls of which, he read: **"The mortal who shall travel over this road alone, without looking behind, be punished by fire, water, and air, without complaint or fear of death, shall be brought again to the light of day, and be prepared to receive the mysteries of the God Osiris."** At this moment three Priests, masked with heads like Jackalls, and armed with swords, by act and word, and portrayal of awaiting dangers, still further tested his courage. If he did not falter, he was led to a hall of fire, where were a burning bush and other material all aflame, through which he had need to hasten, to save his life. Then he encountered a stream of water which he must swim across, holding in one hand a small lamp, the light of day being excluded. He landed on a small platform which gave way, and left him hanging by his arms over a dark abyss; from which came a gust of cold air, that extinguished his lamp, and left him in total darkness. Thus he had been tried by the four great purifying elements, Air and Earth, Fire and Water. After a few moments he was released and conducted to the Sanctuary of Isis, where, under a glow of light, the Priests were standing in two ranks, clad in ceremonial dresses, singing an ode of welcome, and congratulated him on his courage and escape. On the walls of this room he beheld the symbolical representations of the productive heat of the sun, the ceaseless duration of eternity, and the reproductive power of nature. He was then led to the altar, and obligated to reveal what he had thus far learned, to no one who had not had like experience. He was then lectured by an adept, and subjected to still further physical trials and exercises, not so much to test, as to augment his power of endurance. This done, he was prepared for his recognition as a completed novitiate, which took place with much pomp and ceremony, and a banquet, at which certain grave questions were propounded and discussed. After this he was again led to the altar and took another solemn obligation of perpetual fealty and fraternity; whereupon he was clad in a royal robe, conducted through the streets, crowned as a victor, invested with the insignia of the Order, and proclaimed an adept in the sublime mysteries, and was henceforth consecrated to a life of benevolence and virtue. He was also given a **'new name.'** This name was engraved upon a **'White Stone,'** together with a certain mystic sign, which stone he was expected to carry with him wherever he went, as a talisman against evil, and as a means of recognition among the craft. It was undoubtedly to this, then ancient custom, that St. John, in the Apocalypse, alludes, when he promises a **'White Stone'** and a **'new name'** to **'him that overcometh.'** At a later period, the tragedy of Osiris was added to the initiatory ceremonies; giving to the initiate some of the most solemn and impressive lessons ever received by man; teaching, and illustrating to him the great doctrines of death, burial, and resurrection of every one who had attained a fidelity and fortitude that would sooner suffer death than forfeit his integrity.

ANCIENT SYMBOLISM.—As a study, is marvelously rich in result; and at times, tells tales not exactly to a fastidious taste. A lady in any walk in life, from the throne to the kitchen, regards the ring on her finger or bracelet on her wrist a thing of beauty; and so it is. No cultured mind can fail to admire it—and happy is the wearer in her ignorance of its origin. But, my lady friend, go back with me to a period 6,000 years before the earliest Pharaoh of Egypt, when the snake worshipers deafied the serpent, and of his body made a ring, by putting his tail in his mouth, and declaring the circle thus made to be the emblem of eternity; and wore his form in their ears, and around their fingers, wrists, and ankles, and then tell me, if it were not for the fact that your ring symbolizes your hope of an endless life, would it not at once have the charm of its beauty merged in the repulsive idea of the snake? And yet that was the real origin of your elegant ornament. * * * We are far more nearly allied to ancient Egyptian Symbolism than we are accustomed to suspect. A case in point: It has been claimed the making of Asphaltum floors is a very recent invention. And yet Rassam, some 26 years ago, unearthed an Asphaltum floor in every essential like our own, in a room of a burial city on the Tigris, so old that when Moses wrote our earliest history it was an unknown ruin."

The lecture as a whole, contains nearly one hundred pages of manuscript, and required nearly two hours in delivery; it is purely statistical, and should be heard in its entirety to be appreciated.

CONCLUSION.

(Sec. 103.) There is no one thing known in the world, or in ethereal space above the earth, animate, or inanimate, that so many (known) sciences have to be brought to bear, or consulted, in the attempt to elucidate *its origin* as the 'Great Pyramid Jeezeh,' of Lower Egypt. A friend who has been watching the progress of the work on this volume for many months, asked us a few days since: "What has astronomy, higher mathematics, geography, and earthquakes got to do with the construction or use of the Great Pyramid?" While the party acknowledged that it required an extraordinary intelligent mind in the person of its architect. In reply will say: (1.) That without the aid of *astronomy*, the builders of the Great Pyramid, would not have been able to have found the geographical center of all the land of the earth; or a star in the northern heavens to look down the (present) passage-way, and light up the hidden recesses of that greatest of all buildings—nor, the distance to that Deific orb, the sun, that practically governs the whole universe.

(2.) *Higher Mathematics*, are a necessity to the study and thorough understanding of astronomy; and without its aid there would have been no 'coffer,' or 'King's Chamber,' or, even a (perfectly) square base for the structrue in question to stand upon. Which silent *monitor* speaks in unmistakable (mathematical) language.

(3.) *Geography*—the more thorough understanding we possess about this science, the easier the mysteries of *geology* will unfold the formation of continents, and mountain building, together with the history of prehistoric races, and earthquakes.

(4.) *Earthquakes*—a complete and comprehensive theory of the phenomena of earth disturbances, tidal waves, and volcanic activities, by the builders of the Great Pyramid, was what caused them to place that structure where it now stands. That point being the center of all the land of the earth, is the reason why 'earth disturbances' seldom or never visit it. The few that have occurred there in the last 2,000 years, were so slight that they were not a matter of record.

The Story that Earthquakes Reveal.

Taking up the subject of earth disturbances, and what they reveal; or, more particularly to expose what *we do not know*, will say: water seeping down from the surface of the land, and the flows of the oceans, to a bed of perpetual molten lava in the center of the earth; that is not over 500 miles below the surface anywhere, and within 30 to 100 miles throughout the '*torrid zone.*' This is a partial theory for there being more of such disturbances near the 'equator' than at the poles. The reason for the molten portion being nearer the surface in the 'tropics,' is: that the velocity of the earth turning upon its axis, from west to east at the 'equator,' is about 1042 miles an hour, against practically nothing at the poles. This keeps the crust of the earth worn away to the maximum thinness. This is another proof that *terrestrial gravity* does not extend down to the center of the earth. If it does extend down to the center of the globe (?) why is it, that the 'Mississippi river' continues to flow south towards the equator, when it is positively known that the mouth of said river, is 4 miles and over, farther from the center of the earth than at its source (?) and yet that river has a little over 3 inches fall to the mile, or over 10,250 feet, from its source to the Gulf of Mexico.

While there are more seismic disturbances throughout the 'torrid zone' than in the 'polar regions'; there are more seismic disturbances in the 'arctic' than in the 'antarctic zone.'

Our theory for this is: *pressure*; there being more land surface (above water) in the 'north frigid,' than in the 'south frigid zone.' Weight is constantly being added to the north frigid zone from its frozen waters; and here we will indulge in another theory, that—when the ice gathers there in sufficient quantity, the earth will temporarily lose its polarity, and a cataclysm will be the result.

There should not be any regularity about this occurrence owing to planetary interference, sô it is liable to vary from 50,000 to 150,000 years.

Most 'tidal waves' occur in the tropics and are supposed to be caused by eruptions at sea.

The 'Pacific Ocean,' from Alaska to Cape Horn, on on the west side of North and South America, is slightly higher than the Atlantic, on the east side of these same continents. The difference in the elevation is: the Pacific is about 2 feet higher in Panama Bay, at Panama, than the Caribbean Sea on the Atlantic is at Aspinwall. The waters of the Pacific Ocean at high tide run through the Straits of Magellan toward the Atlantic; it comes to a standstill at low tide, but never ebbs.

If there is an underground outlet of the Pacific Ocean, under the continent of North America, to the Gulf of Mexico (and we think there is) the elevation of the Pacific mentioned above, would account for the 'Gulf Stream' both for its *force* and *heat*.

Volcanoes:—if it were not for the 1001 burning mountains on the face of the globe, to act as vent holes, in releiving the great force of molten lava, by allowing a portion to escape, (that produces the earthquakes) the earth would split open every day.

All continents have been built up from their west coasts (since the last change of polarity) and sink first from their east coasts. But the changes of this character, take place at very long intervals, by what we recognize as earthquakes. However, a change of polarity *might sink any continent*, with the *noted exception* of the territory that lies within a circuit of 100 miles, (more or less) of the Great Pyramid, and that will *not sink* in the next 250,000 years. (See Part I. for explanatory theory on this subject.)

All mountain ranges running east and west, are older, (by far) than those running north and south, if over five miles in length. And all mountain ranges running north and south, extending along the east coast of each continent, are older than the chains of mountains running north and south, extending along the west coast of each cnotinent; where 500 miles or more intervene between ranges.

The subject of the formation of continents is too extensive and complex to treat—even in a single volume—much less in a single article.

A few notes, however, giving the exceptions to all general rules on this subject—will not be out of place here. Viz:—Yucatan, for instance, has been formed at (at least) three different intervals; the eastern portion being the oldest, and ranking in age with (a portion of) Panama, all of Easter Island, and Northern Egypt. While the western portion of Yucatan is second in age of formation, and we would place its formation to date with all the principal territory of the Central American states, extending from the Isthmus of Tehauntepec, east to the western boundary of Panama. And the northern portion of Yucatan still later and ranking in age with the Isle of Cuba, which is older than Florida.

Our *earth disturbance theory* may still further be elucidated, by a glance at the map of the principal 'mineral fields' of the world. Viz.—(we have reference to the *precious metals*) gold and silver are found most extensively at the extreme ends or edges of continents. We claim that the principal depository of the precious or heaviest metals, are at or near the center of the earth, in a molten state. And are thrown to the ends of continents, during cataclysms and polar changes; when the earth is supposed to turn around in less time than the atmosphere that surrounds it; thereby disrupting the continents. We also believe that there are other metals of still *greater specific gravity* (than gold and silver) in a molten state, near the center of the earth, that we have never seen; they being too heavy to be forced to the surface.

Referring again to the subject of mountain building, will add: that the popular conception is that mountain chains are due to the folding and plication of strata; "but careful study (say the great lights of cyclopædia makers) of their structure shows that these are but accidents of structure in no way essential to the formation of mountains, and sometimes absent." The theories of De Montlosier and J. P. Lesley, on the nature and origin of mountains and valleys, and to James Hall for further elucidation and illustration of North American geology; are probably the most popular and best received of all writers on this subject.

But in the main, or principal theories of these gentlemen we beg to differ.

There are so many exceptions to their theories that it would take a volume larger than this one we here present, to combat each, even with a passing notice. We will indulge, however, with a few exceptions: *viz.*—in the State of Pennsylvania, the principal coal measures—varying from a few inches to 140 feet in thickness—are located underneath their highest mountains. One of the most productive coal mines in the State of Illinois, is located deep down beneath a level plain. And the most productive and most extensive coal mine in Chile, is located at Lota, on Coronell Bay, and extends under the Pacific Ocean. The entrance to which is on made land, that rose up during a great earthquake in the early part of the last century from the bottom of the Pacific Ocean. Previous to which, this spot was ten miles from shore. If the theory of the production of all coal *measures* is correct, that they were produced from *great forests of timber* once on the face of the earth; wherein are the theories of these scientific gentlemen to be taken?

In the State of Utah, there is a *small mountain* of 'rock salt,' that can be quarried out like stone; and yet this elevation is entirely covered with heavy timber.

The question of the geological age of mountains is twofold, including, first, that of the deposition of the rocks of which they are composed, and second, that of their uplifting and erosion. Elie de Beaumont, considering only the latter question, supposed all mountain chains having the same direction on the earth's surface to be of the same age; but this notion is no longer tenable, since a great mountain chain such as the Appalachians, exhibits considerable variations in different parts of its course, from a N. and S. direction in parts of New England to one nearly east and west in other parts of its extension. As regards the age of the rocks in this great chain, while the Green and White mountains, the Adirondacks, and the Blue Ridge are *eozoic*, the Catskills, the Alleghanies, the Unaka, and the Cumberland ranges are composed of *palæozoic* sediments and the whole Appalachian system was not uplifted until after the deposition of the coal measures.

Electricity and Not Direct Heat that We Receive From the Sun.

It is supposed that *heat*, *light* and *motion* are component parts of each other; from the fact, that any two of the 'trio,' produces the third. But we do not know (at least, our principal scientists do not know) what heat is. Why? Because our greatest astronomers say: the 'sun' is *hot*. It is *not hot;* for the simple reason that the nearer you approach it the nearer you come to an *absolute zero*. To test it, clime to the top of any mountain over three miles in altitude, and see there the *ice* and *perpetual snow*. Or try a balloon ascension up to 18,000 or 20,000 feet, and *then say:* that it gets warmer as you approach the sun. We have witnessed both of these experiences. We will put your query, then why is it warmer on the earth in the sun-shine than in the shade? or at mid-day than at midnight? We will attempt the solution. It is an electric condition; but what is electricity? *No one knows*. All we can attempt to do with it is: to harness this invisible

'Deific substance,' and unilize its force for the benefit of mankind where power and light are needed. We designate it by many pet names, such as 'upper and lower current,' 'hard and soft side,' 'positive and negative poles,' etc.

For the lack of a better appellation, we will use the latter terms. Viz: 'positive' and 'negative.' And, after naming the sun as the depository of the great positive (force) battery of the *Universe*, and the planets that surround it as the depositories of the negative force, we will reason with you why the sun is not hot.

(1.) Because it contains only one component part of heat, 'the positive.' And, until it comes in contact with its opposite force 'the negative,' it is perfectly *passive* as to force, light, or heat. The earth as a negative battery, (to the sun) does not transmit its force to any inanimate substance upon its surface, or even the atmosphere; and it ceases with all *animate creatures* in proportion as their feet are taken above the level of the oceans. (2.) If the sun had contained real heat, instead of one of the component parts of heat it would have been burned out before it had been in position six months. (3.) Sunspots.—Did you ever look at the sun with a powerful glass, or telescope when (what are called) sun-spots were forming? and if so, within one hour see those spots increase from (apparently) the size of your thumb, to the size of your hand? What does it convey to you if you believe with the mass of scientists that solid matter is being destroyed? Simply this: that when you first saw the spot (apparently) the size of your thumb, it was a chasm 5,000 miles across it, and at the end of one hour it had increased to the size of your hand, or was over 185,000 miles across it. Does not any sane mathematician *know*, that if the space of 185,000 miles of solid matter was destroyed, on the face of the sun to any considerable depth, in one hour's time, that it would cease to exist inside of a year? Furthermore, the *combined heat of a thousand volcanoes concentrated into one spot*, could not cremate that amount of solid matter in one hour's time.

The fact that the sun has been known to exist for several thousand years, is evidence that *solid* matter is not destroyed. *Then what is destroyed?* Prof. Mansill, in his great work 'A New System of Universal Natural Science,' says: "The sun is not hot, but is covered with *snow* many miles in depth; and it is this substance that is destroyed, or melted, and sent up in vapor, to return again as light snow, without any rain cloud, when cooled off, and the sun again becoming normal, after an electrical disturbance."

Which disturbance is caused by the extra (or over balancing) negative force thrown towards the sun, at a conjunction of planets, while passing from 'perihelion to aphelion'. A similar disturbance is sometimes produced (although in a several million times milder form) by a thunder and lightning storm passing over some high elevation where an electric telegraph line extends down into a valley; the extra *positive* current in this case wrecking the plant—if the forces are not separated at the first flash.

An Epitome of Mansill's Universal System of Natural Science or the Reciprocation of Matter and the Forces.

"If all matter was evenly diffused through space there would be no motion of matter. But we find the matter collected together in a nucleus as sun and planets, and these present a system of motion of matter through matter. The most dense bodies move through space and matter with the greatest velocity in proportion to their densities. All planets, comets and satellites go through a reversible change of motion, volume, distance and density at their perihelions and aphelions each orbital revolution; this being effected through reciprocating electric currents or lines that exist and undulate between the sun and planetary bodies, and which currents are used to carry on these planetary changes with. These changes continue from perihelion to aphelion and aphelion to perihelion again, and are in proportion to the amount of ellipticity in their several orbits—the greater the ellipiticity the greater are the changes.

All bodies move through space in proportion to their densities—those most dense move with the greatest velocities on the average in proportion to their densities. All matter composing the earth, or any body of matter, denser than the average density, promotes its motion in the same proportion. All matter of less than the mean density helps to retard its motion through space in the same proportion.

The motion is the equivolent of the cohesive mass—the cohesiveness is the equivolent of the density of motion—or by this dense matter is held cohered together and balanced or rides on a cushion of motion. (Or hydrogen at the density of water can impel a motion of 20,000 miles an hour through space, while as hydrogen gas it could only produce a motion of 1⅔ miles an hour. This is on the principal or base that all matter moves through space at the average of 20,000 miles an hour for each one time that it is the density of water or any part thereof.)

The heat which is supposed to be received from the sun by spontaneous emission, is in reality the electricity undulating and vibrating between the earth, the sun and every other kindred or solar planet, regulating their motions, densities, volumes and distances.

The earth and other planets consense and part with electricity to the sun and other planetary bodies while passing from perihelion to aphelion. The earth and other planets absorb electricity from the sun and planets as they expand while passing from aphelion to their perihelion.

All volatile matter, while receiving electricity, expands and moves its own average distance farther from its own center also from the sun, and it has a tendency to retard its mean motion; while this is reversed when matter parts with electricity, it then condenses and has a tendency to move toward its own center and the sun (or center) and increases its average motion power in the same proportion.

It is when the planets are about passing their perihelions, aphelions, inferior, superior and longitudinal conjunctions, or anything that interrupts these electric lines or currents, that most of our worst earthly meteorological disturbances occur, such as unusual earthquakes, volcanic eruptions, great storms and tornadoes and electric ground currents and other electric phenomena—many of our epidemics and droughts are inaugurated and terminated also excessive rains—likewise depressions of atmospheric temperature, or the general results of meteoric irregularities, etc., take place about these times.

Matter and force are always the same in quantity, but the form of matter changes.

Kepler's third law is constructed so that the square of the periodic times of the planets around the sun are proportional to the cube of their mean distances from the sun. Kepler also found that the planets moved in eliptical orbits."

Does the Sun's Heat Reach the Earth as is Supposed? We Say No.

[*From Mansill's Almanac for 1901.*]

"The earth's heat does not come from the sun's cold and zero surface. The sun does not radiate heat by spontaneous emmission. The earth's heat or high temperature as maintained about the tropics does not come direct from the sun, but is produced on the earth's surface by and through the cold electric currents undulating between the sun and earth's atmosphere, and the volatility of the atmosphere and water keeps on absorbing this cold electricity and expanding, and at the same time producing a chemical effect among the vapors and volatile elements of the earth's surface, and produces or generates the heat or high temperature in the earth's atmosphere. The water, or vapor of the atmosphere possesses a powerful electric absorbing and expanding force for the sun's cold, undulating electricity, which continues to permeate and re-permeate the atmosphere, generating heat and a high temperature in the earth's atmosphere. This expansive force of the water or vapors is seen when the vapors of the water are condensed into rain water of many hundreds of tons to the square mile for every inch of rainfall. While the fluid is in the form of water and vapor both the oxygen and hydrogen appear to have a strong expanding force but when the vapor moves on and about the earth's surface and comes in contact with the decomposing and germinating seeds, the oxygen unites with the carbon and other elements forming carbonic acid gas, and while rising with a part of the vapor in and about the forest and trees the oxygen now leaves the carbon and hydrogen and thus leaves carbon and hydrogen in the wood of trees through the influence of the cold undulating electricity acting between the earth and sun. Therefore, to procure the carbon again we must cut down the timber, construct a charcoal pit or pile, cover the pile of wood with turf sod, soil or sand, burn the pile to drive off the hydrogen and all other volatile matter or elements; this leaves tolerably pure carbon in the shape of charcoal.

These are natural and chemical processes going on under the tropic and in the temperate zones. If we go toward or near the poles of the earth we come in contact with a cold and finally, a zero temperature. If we climb a mountain or go up in a balloon we soon strike a cold, and finally a zero temperature. We have got but a small arc in which to exist. We cannot leave the face of this earth ten miles at any time or anywhere without coming in contact with a zero temperature. The highest atmospheric temperature on the face of the earth is at the level of the sea. The temperature diminishes at the rate of about 15 degrees to the mile going toward the sun, so the nearer we approach the sun the colder it gets until we reach a zero temperature. This being the case, how and where does heat and high temperature get into the earth's surface from the sun's heat? through this 92,000,000 miles of zero temperature,—or where does the sun's heat, so-called; commence and terminate, etc.? Now, gentlemen philosophers, I would very much like for you to answer these questions in truth, as it would save me a great deal of trouble, as I am somewhat interested in the subject. * * * If you would inform me how the heat, so-called, from the sun reaches the surface of the earth through 92,000,000 miles of zero space or temperature, I should like it very much. * * *

There is but little matter in space, therefore there is none or but very little chemical action in space. As there is no heat, so-called, where there is no matter or chemical action going on, or a change of density taking place among the elements of matter—in fact there is no heat produced on the earth until the cold undulating electricity comes in contact with and permeates the earth's atmosphere and produces chemical action and a change of density among the volatile elements—the water and its vapors and the atmosphere; then the highest atmospheric temperature is generated at or about the level of the sea, and this atmospheric temperature, as above said, diminishes everywhere under this arc at about the rate of 15 degrees a mile for every mile that we leave the earth's surface going towards the sun—or at least until we strike or come in contact with a zero temperature; therefore there can be but little or no heat in cold, zero space, or yet but little cheimcal action. We contend that there cannot be any heat in space where there is but little matter, or chemical action, or change of density going on. Therefore as above said, we cannot anywhere leave the surface of this earth ten miles without moving into a zero temperature, even if we go toward the sun. Now as above said, if some one will tell us how the heat of or from the sun gets to the earth's surface through the 92,000,000 (or exactly—91,840,000) miles of space and a zero temperature, and below, without getting cooled down to a zero temperature, we would like very much to know it. It is as easy for the cold electricity to move from the sun to the earth and planets to support their chemical changes of density—and to regulate their volume, density, motions, and distances—and elevate or generate a moderate atmospheric temperature in the earth's electric absorbing volatile elements about the earth's surface as it is for cool electricity generated at a power house to go or be sent to trolley cars to heat them—and furnish cold electricity to heat many other things—many miles from the electric machines or generators. The sun, without a doubt, is surrounded by a zero temperature and its outside shell is composed of snow and ice, but we believe, that like the earth, that its temperature increases and that it becomes quite warm as it reaches some 10,000 or 20,000 miles from its surface towards its center, which center is supposed to be some 400,000 miles or more. The sun, in this condition, could last and perform its work for millions of years, to supply and exchange or reciprocate electricity to and with the planets to support the earth and planetary bodies, changes with which, if it were a fire ball as it is supposed to be, it would not last 30 days—the whole solar system would go, where I do not know nor cannot imagine. It is advocated by some that the planet Mars is inhabited by human beings. This is very doubtful, for Mars has to go through too great a change of density and orbital revolution from perihelion to aphelion and from aphelion back to perihelion again, as there is about 26,000,000 miles of ellipticity in its orbit, and all planets go through a change of volume, density and motions each orbital revolution in proportion to the amount of ellipticity in their orbits. There might be a low class of animal life on Mars, such as fishes reptiles and insects or such things that can live in and about water. If there is anything like human beings living on any planet except the earth it is Venus, as the planet Venus has the least ellipticity in its orbit of any other planet, therefore it has the least change of density to go through of any other known planet; hence human life could exist on that body."

Final Conclusions that our Whole Subject Reveals Regarding the Great Pyramid.

It is not a difficult proposition to speculate upon *any* 'mysterious subject,' that but few people have investigated and obtain followers for the theory. But a mysterious subject like that of the 'Great Pyramid,' that has been before the intelligent thinking inhabitants of the earth for over 5,000 years (that we have history for) during which period, the population has varied in numbers from a few thousand, to 1,555,000,000; and the intelligence has ranked from the *naked nomadic* '*Negrito*' of the Philippines, to the most gifted 'scientist' of the age—it is not so easy to obtain followers, and recognition for a *new theory* regarding it. But few people change their theories of life-long standing, even though their opinions be classed by the masses as purely superstitious.

The Great Pyramid Jeezeh, of Lower Egypt, probably has been the subject of more speculation; caused more people to change their fixed ideas; and, has created more doubts, on more different subjects, than all other visible mysteries in the world combined. For the reasons above expressed, we may be excused for our effort—in the foregoing pages to demonstrate an entire original theory, for the *construction* and *use* of this "First Great Wonder of the World."

If you have closely scrutinized what we have presented for your eximination in the preceding sections of this work, and have read between the lines, where we have presented such opportunity, this recapitulation will have the tendency to refresh your memory. As many people make a tour of the world in eighty days, and try to shade that by a few hours—to such this condensed statement will be in place.

For, they have no time to listen to corroborative evidence, but upon all subjects constitute themselves "Barrister, Judge and Jury." However, to the student that desires to refresh his memory, for either conversation or instruction this statement will not be out of place.

In the endeavor to substantiate our theory regarding this "First Great Wonder of the World" we have diverged from the subject of *Architecture* and *Building*, at intervals, but for a purpose.

We think we have made out an excusable case, for having treated at some length, the subjects of Astronomy, Mathematics, and Seismology with our own theory for Earthquakes. And, also, for using the other "*six* wonders of the world" constructed by man, as comparisons; together with the "Seven Natural Wonders of the Earth."

It is only by comparison, illustration, contrast, etc., that we can demonstrate what little we do know.

We think, however, that we have demonstrated that through the aid of Astronomy, Geography, and Mathematics, the ancient builders of the Great Pyramid, found the "center of all the land of the earth," whereon to erect that remarkable structure; and through the aid of our "earthquake theory," and chronological list of principal earth disturbances, for nearly 2,000 years; that it is located upon the spot of least vibration, and most perfect security from future destruction, for thousands of years to come. *And its builders knew it.*

We stated at the outset of this work that *we* at least *believed* that this mysterious structure was built by a race of people that preseeded ours; with vastly more intelligence than we now possess, or are likely to attain in the next one hundred years to come. And that it was built for an "Initiatory Asylum"; from which all "secret orders" of today are partial imitations. (See index for "Initiatory Degree" in the Great Pyramid." And, as the principal "Secret organization" of men, who built the Great Pyramid, ruled the whole earth at the time of its erection; it is perfectly natural that they should have dictated an "*International code of weights and measures*." The tables of Pyramidal Weights and Measures, contained in this work based on the measurements within the Great Pyramid, stand out as proof of our theory on this subject.

As the principal rulers of the United States, Great Britain and Germany, at this wirting (1907) *viz.*, President Theodore Roosevelt, King Edward VII., and Emperor William II., have each travelled from East to West, and, therefore, can see the necessity for the establishment of an International code of "Weights and Measures"; and King Edward VII., is in the position (with Egypt) to stop any further *depredations* in and about the Great Pyramid, and to suggest the repair of said structure. And this trio of *Illustrious* Rulers, are in such touch with the balance of the civilized world, as to have their confidence in suggesting said *code*. There are a number of men of *wealth* that could and would furnish the means for this purpose; but, it will require the consent of these three principal nations to inaugurate a starting point. Will they do it?

The Great Pyramid Jeezeh was built at least 50,000 years ago; and more likely in the year 55,677 B. C.; reasoning from the *standpoint*—that the whole race of people that lived at the time the Great Pyramid was built, were annihilated later by a cataclysm; and as no cataclysm has taken place (according to geology) under 50,000 years, we think the last named date (55,677 B. C.) more probable. We believe that it was built at some date when the star—"*a Draconis*," was in a direct line with the "pole," and looked straight down the (present) passage way, on the north side of the building. These occurrances only take place every 25,800 years; the last occurrance, and the only one during our present civilization, was in 2170 B. C.; and will not duplicate its position until the year 23,630 A. D.

We maintain that it could not have been built in 2170 B. C. as *ignorance* and *superstition* pervaded the whole earth at that period; and, there has as yet been no reasonable argument produced to prove Divine assistance to its Architect, and assistant workmen, at that, or any other date during our civilization; as claimed by several Egyptological scholars. Further, we claim that it would be impossible to duplicate this building, in its entirety, in this enlightened age, by the combined skill and intelligence of all nations. For one reason alone, even if we could prepare the different parts, we could not place them in their present (perfect) position, by any known process in this enlightened day, owing to their immense size and weight. So the builders must have possessed the secret, (lost art) of "overcoming gravitation," or its equivolent, for this purpose. Further, we could not prepare, with the tools at our command, many of the hard pieces of granite that are in position, owing to their extreme delicacy of finish, and their immense size and weight. Our finest measuring rods fail to register the same result, twice hand-running, in the hands of our most skillful mechanics, on a building the size of the Great Pyramid. And yet, with all the measurements that have been made in and around this building, in the last one thousand years, we have been unable to prove any imperfection in its perfectly square base.

It is also *evident* that its passage ways and chambers were well lighted, by some process of *reflected* light, still unknown to us. It is almost positively certain that it was not lit up by lamps, or by *any* method that we are familiar with; for there is no evidence of any place whereon to hang or sit a lamp, and no receptacle wherein to burn any illuminating substance.

All the chambers give evidence that (when they were used) they were prepared for perfect ventilation, and no vitiated or impure air was tolerated by those ancient builders.

Does this not demonstrate that this building was not erected by an ignorant race of people?

Is there a more plausible theory than the one we have presented? We leave this portion of the subject with you. And—*so mote it be.*

Astronomy, Astronomical Symbols, Elements of the Solar System, and Theories Regarding the Planets, according to the Latest and Best Authorities.

EXPLANATIONS OF ASTRONOMICAL SYMBOLS.

Sun - -	☉	Venus -	♀	Jupiter -	♃	Neptune -	˚˚	Opposition -	☍
Moon -	☽	Earth - -	⊕	Saturn -	♄	Conjunction	○	Ascending Node	☊
Mercury -	☿	Mars -	♂	Uranus -	♅	Quadrature	□	Descending "	☋

The earth enters the sign ♈ (*Aries*) each year about Sept. 22d; it enters ♉ (*Taurus*) Oct. 21st, and ♊ (*Geminii*) Nov. 21st; ♋ (*Cancer*) Dec. 21st; ♌ (*Leo*) Jan. 20th; ♍ (*Virgo*) Feb. 20th; ♎ (*Libra*) March 20th; ♏ (*Scorpio*) April 20th; ♐ (*Sagittarius*) May 21st; ♑ (*Capricornus*) June 21st; ♒ (*Aquarius*) July 21st; ♓ (*Pisces*) Aug. 22d.

TABLE OF SOME OF THE ELEMENTS OF THE SOLAR SYSTEM.

NAME OF PLANET.	Diameter in miles.	Axial rotation.			Velocity in Orbit. Miles per hour.	Greatest distance from the sun in miles.	Least distance from the sun in miles.
		d.	h.	m.			
Sun	852,584	25	7	48			
Moon	2,160	27	7	43	2,273	* 251,947	* 225,719
		h.	m.	s.			
Mercury	2,962	24	5	30	105,336	42,665,560	28,119,716
Venus	7,510	23	21	23	77,050	66,585,947	65,677,009
Earth	7,925	23	56	4	65,533	92,965,489	89,894,951
Mars	4,920	24	37	23	53,090	152,283,936	126,340,516
Jupiter	88,390	9	55	21	28,744	498,603,768	452,782,530
Saturn	77,904	10	29	17	21,221	921,105,027	823,164,139
Uranus	33,024	9	30	?	14,963	1,835,700,825	1,672,001,279
Neptune	36,620		?		11,958	2,770,217,344	2,722,325,120

	Mean distance from the sun in miles	Variation or inclination of orbits to the plane of the ecliptic.			Siderial period.	Synodic period.	Deg. longitude ascending Nodes.
		deg.	min.	sec.	Days.	Days.	
Moon	* 238,833	5	8	39	27.32	29.5	
Mercury	35,329,638	7	0	5	87.96	115.8	46
Venus	66,131,478	3	23	29	224.70	583.9	74
Earth	† 91,430,220	0	0	0	365.25		0
Mars	139,312,226	1	51	6	686.97	779.8	48
Jupiter	475,693,149	1	18	52	4,332.58	398.8	99
Saturn	872,134,583	2	29	36	10,759.22	378	112
Uranus	1,753,851,052	0	46	28	30,686.82	369.7	
Neptune	2,746,271,232	1	46	59	60,126.71	367.5	

The ecliptic circle, or earth's orbit, is divided into twelve equal parts of 30 degrees each. The zodiac is also divided into 12 parts, called signs of the zodiac, of 30 degrees each and including 9 degrees on each side of the ecliptic; these 12 signs of 30 degrees each constitute the 360 degrees of all celestial circles, and we may say at all distances from the center of the sun. The planets traverse around this circle in various periods of time, and each one at various distances from the sun, and at irregular motions.

Kepler's third law is constructed so that the square of the periodic times of the planets around the sun are proportional to the cube of their mean distances from the sun. Kepler also found that the planets moved in elliptical orbits.

All bodies of matter move through space in proportion to their density—those most dense move with the greatest velocities on the average in proportion to their densities. All matter composing the earth, or any body of matter, denser than the average density, promotes its motion in the same proportion. All matter of less than the mean density helps to retard its motion through space in the same proportion.

The motion is the equivalent of the cohesiveness—the cohesiveness is the equivalent of the density and motion—or by this dense matter is held cohered together and balanced, or rides on a cushion of motion.

* Distance from earth.

† It is 91,840,000 according to Wm. Petrie, C. E., from pyramidal measurement.

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