THEORY

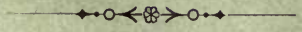
of

COSMIC REASON

by

I. Vinogradoff.

[Address: Russia, St. Petersburg Vladimirskaya № 7, I. 26.]
Member of the Russian Astronomical Society.



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Preface.

Action or Thought, founded on the laws of nature, and not violating the rights of others, is Morality. **The Author.**

It seems to me that in the issue of any publication every author must have in view the aim of that publication. These aims are of course subjective, and mine amongst the number; but I specially desire to give to the aim of my present work a broad human significence. What I now offer to the public and to the learned world is the labor of fifteen years of earnest observation and research, a labor called into action by life itself. Its fundamental idea is human morality.

What is morality? Up to the present we kuow no definition; but the saying "so many men so many minds" can well be applied to the extant definitions of morality. There is no society, there is no family, there is no individual unable to set forth his or its own moral principles, meanwhile societies and families and individuals are so various in their moral developments that to reduce these developments to unity is beyond all human possibility. It might seem that religion should be able to effect this unity, but in the promises of peace which different religions supply there are so many contradictions that unity is inconceivable. The Christian says — Morality is the Gospel; the Mahometan says it is the

Koran; the Chinaman says it is the teaching of Confucius; the Indian says it is the doctrine of Buddha; in a word every state raises its religion into the ultimate standard of morality. Very often these religious creeds are directly contradictory to one another, and would seem to exclude the possibility of the very coexistence of nationalities; not the less we see Chinese living peaceably with orthodox Mahometans, Sheahs with Buddhists and Pagans with Christians. Morality, it follows — putting on one side all the various state religions and creeds, all social and family principles — must root itself in nature, and only that which answers to the fundamental laws of nature, only that which no philosophy can circumvent — can serve and must serve as the foundation of all morality. Let the ascetic say the crucifixion of the flesh is the supreme morality; the monk that withdrawal from the vanity of the world is its loftiest form; the world will remain not the less a world of life, of joy, of pleasure, of grief, of pain, of the active exchange of vital elements, and will neither become ascetic nor conventual.

Fanatics may preach the absolute purity of their own race or of their own religion, they may demand the sacrifice of human lives for the spreading of their ideas, but their fanatical dogmas will not subdue the whole world, and however ferociously they may slaughter the rebellious and heretical life will take its course, lap them in its waves, and efface the monstrosities of superstition which demand such human holocausts . . . . . .

Love alone, only the natural love of human attachment, founded on the propagation of onès own species, wells up, drowns all the creeds, and successfully resists all the restrictive enactments of human intellect. It unites in peace all principles, it perfects all races, it assimilates all religions, and compels people to live in peace among themselves who hold the most sharply antagonistic and irrecomileable convictions. All this it can do for the simple reason that it is the way, the

only way of nature herself and involves the high significance and function of men as a civilizing force, the perfecters of earth and earthly culture. In it is wrapped the conception of morality, the growth of which is the natural product of moral law. To establish this proposition from observation of nature herself, has been my aim in this labour of many years.

The Author

Various theories

of the formation of the Earth.

The question What is our earth? has interested humanity from the very beginning of world history. We have in the Bible undoubtedly the first indication of the origin of the earth. We remember how in the book of Genesis the creation of the world is described: In the first day God created the world, i. e. vital matter, from which was afterwards formed all the rest; in the second day the firmament or visible heavens — hence it is evident that in the second day the earth already existed, in as-much as the heavens appeared above it; in the third day God divided the waters from the dry land, and commanded the earth to bring forth „grass and herb".

Here then are three functional principles according to the Bible, furnishing the foundation of our earthly globe: first, living matter; second, the mingling of the elements in the heavens and the earth; third, the productive activity of the earth on the basis of cosmic law.

This third stage in the creation of the earth long remained in human judgment the sole functional destiny of our sphere. Men looked upon the productiveness of earth as on a divine gift, in which the favor of the Creator was revealed and His holy will made known, in mercy or in punishment for sin; and this view is still prevalent amongst the uneducated classes.

For a long long time, perhaps tens, perhaps hundreds of thousands of years, the earth appeared to man in the

form of a magic table-cloth, which sometimes spread before him an abundant feast of good things, at other times lay in the bare hard folds of Famine, but yielded him no clue to the nature of its own existence or its claïms upon the creatures living on it.

That our earth is a globe is an idea which was unknown to men in ancient times. Our Bible in revealing the mysteries of creation, says not a word abouttheir form, and only, as it were, briefly hints that all the heavenly hosts in the starry sky are mere auxiliaries of our own earth.

With the development of the inquisitive human intellect, with the increase of human knowledge, men began to interest themselves more and more in the world beyond the clouds, and there is no doubt but that the conception of earth as a globular body was familiar to the ancient Egyptians. We find the first beginnings of astronomical observation in Egypt of old, but as the views of those early times never went beyond direct human interests the, science of those days, worked in the same narrow groove, and all the natural phenomena of the heavens were applied as political signs and warnings, being sometimes referred to the actions and destinies even of individual potentates.

Thr earth as a globular body entered on the scene in the middle ages of the christian epoch, and, little by little, a conviction of the spherical form of our planet forced its way into the mind of man. Columbus was the first who decided to put to the test this scientific confiction, and he set out with a handful of companions to the West with the assurance in his own mind that he would return home from the East. Men of science by their travels, and discoveries have dispelled all doubts as to the fact that our earth is a sphere similar in form to other heavenly bodies, and astronomy, since the confirmation of this fact, has occupied itself with the study of the earth's orbit, and with determination of its relative position amongst other planets and its relation

to the sun. An immense number of various theories as to the origin and formation of the earth have sprung into existence, and at these we must now glance.

In 1745 the astronomer Buffon expressed an opinion that our earth, in common with the other planets and their satellites, has been formed from liquid fire, which has been separated from the body of the sun. This phenomenon, he assumes, might be caused by collision between the sun and some comet, which may have torn away a mass of burning matter and scattered it in space thereby producing our planetary system.

In 1775, Kant, expounding his theory of world origin, supposes that originally there must have existed a vaporous form of matter or cosmic cloud, which in the form of separate particles filled the whole universe, and that, in consequence of concentration, separate worlds, amongst them our earth, came into being. The ring of Saturn, visible from earth, presents itself as the very same gaseous vapour from which the planet Saturn was formed.

Kant's theory of the formation of worlds is maintained by William Herschel (1789), who says that the stars acquired their globular shape from the action of centripetal forces, and, as an example of a similar phenomenon points to his own investigation of cloud spots, in which a concentration of matter round a centre, had proved in cases visible to the naked eye. Of such cloud-spots he had himself traced more than two thousaud three hundred.

In 1795 Laplace presented his hypothesis of the formation of the solar system from gaseous vapour. Like Kant he says: all the planets move round the sun from West to East; and almost in the same plane: their satellites move around them in the same direction and again almost in the same plane. Finally the sun, the planets and their satellites revolve upon their axes in the same direction and almost in the same plane in which proceeds their common forward movement. Such harmony is no mere coincidence, but points to

some common cause upon which all these movements depend. The action of this cause is clearly proved from the circumstance that the orbits of the planets and their satellites have a very slight eccentric, whilst the paths of comets passing through the solar system present curves with a great eccentric, though their fluctuation is not subject to any law.

Both these scientists regard the origin of the solar system as a widely extended fluid which, at some time or other, in the form of atmosphere, surrounded our central luminary. They suppose that the excessive heat of the sun originally exercised an influence far beyond the limits of the orbits of any of the planets, and only gradually reduced its sphere to the present dimensions, somewhat as the renowned Star of Bethlehem showed during several months an unusually bright light in the constellation of Cassiopeia.

Laplace assumes that the cosmic mass revolved at first around its centre, and, ever thickening and concentrating more and more, formed, by degrees, our sun, whilst the planets appear as the outcome of the separation from this central mass of ring-like fragments which preserved in their movement the same general direction. The small asteroids between Mars and Jupiter are formed from clouds of these vaporous rings, which at one time must have fallen to pieces in this part of solar space.

Laplace asserts that the matter which concentrated into the solar system had formerly the shape of an expanded spheriod. In proportion to the contraction of this spheriod, the rapidity of its revolution necessarily increased; rings of its gaseous matter began to separate themselves from the main mass, and in their turn became converted into globes, and these globes repeated the same process, producing still smaller globular bodies. Thus from the first detached rings were formed the planets, and from the second their satellites, while from the great central mass was formed the sun.

The Belgian scientist Plato, who shared the theory of Laplace, confirms it by experiments with liquid bodies in regular rotatory motion in liquids through which he found that portions of the rotating matter, separating themselves from the mass, assumed a spherical shape, but no longer revolved like the main body, nor continued a motion of the same rapidity. Thus the relative velocity of the planet around its sun remained a problem to which the experiments of this savant could furnish no solution.

Herbert-Spencer endeavours to reconcile the hypothesis of the formation of our solar system from cosmic gaseous cloud with contemporary science. He admits the existence of a cloudy mass between Sirius and the Sun, at a distance of 27½ billion miles. By means of repulsion and attraction of the atoms was produced a warmth, which resulted in their chemically uniting, when however the temperature of the united mass was cooled by the escape of rays. fragments began to form. These flakes received another direction in space, pressing towards the limits of centripetal force, acquiring in their course a spiral movement which resulted in the present solar system.

In the comets Spencer sees a kind of matter perfectly similar to that from which according to his theory, the whole solar system was formed.

Of new theories of world origin we may point to those of Meyer and Fey. Both these scientists say that the universe originated from matter scattered in infinite space owing to the concentration of this matter round various centres, under the influence of attraction. Meyer argues that the sun's fire is caused by the incessant falling of cosmic bodies, descending upon its surface with a velocity not less than 600 kilometres per second, a perpetual shower which continues to the present time. Fey denies the continuance of this shower, and assumes that were this fall of cosmic bodies continuing to the present time the sun, growing ever larger and larger, would

have attained such a degree of attractive force as to draw to itself the whole planetary world — a phenomenon which is not observable.

Basing their argument on the spherical conformation of the earth, the majority of scientists conclude that it existed at one time in a liquid state, since it is known by a mechanical law that every fluid body revolving in its axis takes this spherical form. This view is supported by the researches of Plefer. John Herschel and Henessay, the most precise proof, by means of the oscillations of the pendulum being presented by Pratt, who demonstrated the thickening of the strata towards the Equatorial line. The French scientist Deloney and the Englishman Erie, engaged in similar researches and by their calculation it would appear that the thickening of the earth's crust at the equator embraces a mass 5400 miles long, 1330 miles broad, and about 5 miles thick. This thickening of the crust, according to Erie, is the result of the attraction of the sun and moon, the united action of which is the cause of the slow and complicated movement of the earth's axis known to astronomers as "procession" and "nutation". Zoopan, however, in his "Foundations of physical geography" asserts that investigations of the earth's surface and the thickening of the earth's crust, conducted by means of the pendulum, have not always furnished the same result.

But if there exists a school tracing the formation of the earth from a molten mass, which, in consequence of some cosmic accident, was torn from the substance of the sun, broke in fragments, and formed the planets and their satellites, there exists also another theory, which asserts the formation of the planets from gaseous cloud, and a representative of this theory is the American Sterry Hunt. Hunt considers that the solidification of the earth took place from within. As the starting point of his researches he assumes the existence of a cloudy gaseous mass of a high temperature, which,

as an enormous globe revolving on its axis, must gradually cool. The whole mass was uniform and began to solidify upon the surface, when, having become fluid, or even solid, it acquired weight and began to gravitate towards the centre, where again it attained a raised temperature. By reason of the continual pressure taking place in the mass, loss of warmth and continuous solidification went on unceasingly, till the fluid state was reached, i. e. till there arose certain amalgamations which could remain without decomposition in the centre itselft which is to say when certain metals could firmly amalgamate with oxygen. Afterwards the process of solidification continued until the earth was converted into a large fluid globe of molten matter surrounded by burning vapours. In such a mass solidifaction proceeded from the surface to the centre and round this centre the solid matter concentrated, since here it was more compressed than on the surface.

The scientists Hopkins and Fairbairn share this theory, holding that solidification must begin from the centre since compression raises the melting point, and therefore the cooled strata, sinking from the surface, did notmelt in the interior of the earth but only thickened and condensed its general mass.

Young, in calculating this pressure towards the centre on the earth's surface, reckons it capable of reducing a granite mass by a whole eighth. Water at a depth from the surface of so geographical miles is twice the surface density, and at a depth of 80 miles would weigh like quicksilver, while steel would shrink to a quarter of its natural bulk, which, according to Herschel's calculation, corresponds to a pressure of 300.000 atmospheres.

The French geometrician Poirsson also supports Hunt's theory of solidification from the centre outward.

Which of these theories of the origin of the earth is actually true heaven only knows, but it would seem that Hunt's nation of the formation of earth from gaseous cloud, cooling from within, is the least probable. For if

the cooling process which Hunt describes really happened as he supposes then afterwards, when the centre of the globe became molten under the accumulated pressure and aquired an enormous temperature, in that centre must have taken place a precisely contrary phenomenon, the molten matter in the bowels of the earth, being lighter must have risen to the surface which would again receive a fluid, and this time a molten form. But we can remark no subterraneous phenomena to confirm the idea of such a process.

The scientists Tomson and Farbes assert that only the upper stratum of the earth shares in the changed atmospherical temperature of day and night, winter and summer. Below this we find a stratum of fixed temperature at a distance of from 80 to 86 feet below the surface, where the thermometer indicates always from 9 to 10 degrees Reaumur. From this stratum downwards the temperature steadily rises one degree to every 135 feet, so that at a depth of 20.000 feet exists a temperature raised to the boiling point of water, and at a depth of from 9 to 10 miles the stone must be red-hot. On this assumption all the centre of the earth's sphere must consist of liquid fire.

Fourier, going further in his researches, points out that by the laws of the transmission of heat, if we admit the melting of stone at a temperature of 4400 degrees Reaumur the solidification of earth would require 200,000,000 years or, if the melting point was ouly 300 degrees, the process of cooling down would still require 98,000,000 years. Such then is the antiquity of our globe, it we can believe science!

On examining all these existent scientific theories of the formation of earth, we see that they all in common recognise in it a cosmic accident; that they go no further than an original chaos of fluid or gaseous matter, which was converted into a planetary form under the influence of its rotation round an axis. They leave out of account organic life, intellect, free will; and explain all the earths

movements and changes by reference to the law of cosmic gravitation and attraction, though they clearly set out the spaces separating the heavenly bodies in figures so overwhelming that separate planets can only figure in the scheme of the Universe as points, as which they must necessarily be lost in the mass of similar points, and only fall under human observation thanks to a fortunate cosmic coincidence.

By the calculation of astronomers, light from the very nearest of the stars reaches our earth in not less than 3 years. Keeping in mind that light travels 200,000 versts a second, and multiplying this distance by the number of seconds in three years, we obtain in result a total distance of 18,921,600,000,000 versts.

If we reduce our earth to the eighth part of a vershok, that is to say to the size of a pea, we shall find its diameter equal to 2,307,000,000 such parts, and dividing the first distance in versts by the second in eigths of a vershok, we shall see that if two planets, the size of our earth, should be reduced to the size of a pea; they would lie in cosmic space at a distance of 8212 versts from one another; while if we take for example two planets as large as the sun, i. e. having a diameter 114 times greater, reducing the scale on a corresponding principle, these two pea suns would be separated by 72 versts. Is any special force of gravitation conceivable between such peas, divided from one another in space by 8212 and 72 versts respectively?

Let us turn again to the Bible. The book of Genesis which describes the creation of the world, was written by Moses, and written as theology affirms, under the inspiration of the Holy Spirit, Nevertheless Moses as a man even inspired could not convey to mankind information which he himself did not posses.

We will put on one side, for the time, the spiritual side of the teaching concerning the earths origin contained in Genesis, and regard the author of that book as a man. We know from the Bible itself that Moses

was born in Egypt, a country of high culture for that time, that he was educated under the guardianship of Pharaoh's daughter, and that he grew up in the Egyptian court. Bred under such conditions he was no doult a man of learning, having been surrounded from infancy by the most learned scholars of the age. The tabernacle of the covenant constructed by him plainly proves that he was familiar with the laws of physics and electricity. The astrology of that time occupied the place of modern astronomy and, beyond question, the systematic movement of the stars was known to contemporary Egyptain science. Moses then, himself, thoroughly understood what he describes in the book of Genesis.

We ask then how did he look upon God's world, Everywhere he regards it, we find, as a world of living intelligent creatures.

On different days of creation God formed the sun moon and stars, the fish and the birds, the man Adam and the woman Eve, all living beings passessing the faculties of Reason and of Will. And now look at what is said in Genesis specifically touching the creation of the earth itself: — "In the third day God separated the water from the earth, and commanded the earth to bring forth grass and herb".

The word *commanded* clearly intimates the animal life of the world, since in commanding any one to do anything it is assumed that the being who is commanded can listen and obey. On the independant reasonable existence of the earth, our labourers and our luminaries in the world of science have never dwelt; they have never even looked at the earth from that point of view which it is my intention to occupy in the present research. It is of this cosmic reason that I have now to speak.

The Earth

as an

Animal Organism.

If it were within the limits of human possibility to anatomise the earth, we might reveal by dissection many curious and interesting facts about its construction, but unfortunately man, himself a tiny insignificent particle of his own mother earth, can do nothing of that sort; — nevertheless his inquisitive intellect is not altogether arrested in its course by the fact of this impossibility, but goes on striving to penetrate the hidden mysteries of the globe. His method of research, though not anatomical but analytical, consisting often of conjectures and suppositions, confining itself to the search after analogies, or taking the path of geological investigation and the study of physical laws, enables us to reach a general comprehension of the earth's formation, and of the properties of nature while astronomical observations tell us from day to day, by what paths and with what velocity our planet is travelling through the immensity of space.

In fixing attention upon the earth as an animal organism; I must point out those distinguishing features which in general, may be said to characterise such organism. These features are: — a head, the organ of governing reason; feet, the organ of movement and transport from place to place; breath, the organ of vitality itself, and finally all the other factors characteristic of organic life in animals.

As I have already said anatomical examination of the earth is inconceivable for men, and he is compelled by the nature of things to resort to other expedients to forward his researches.

The first of these expedients is analogy, for the application of which we naturally turn to the globe of the earth. Astronomy and the physical geography based upon it, show that the sun and the planetary system surrounding it move through space in one direction, and as though in one plane. When we turn our attention to the internal and external planets we see that the former are visible from the earth always to the East and West, the latter to the South, South-East and South-West.

If we take the position of the planets on the map the field of movement appears in the form of a widespread funnel or watering-rose of flattened conformation. In the centre of this circle is the sun and along its radii towards the circumference are the planets, the circumferance being somewhat in advance, indicating that the planetary world moves in advance of the sun, and not behind it.

As every animal moves with its head foremost, and as the earth moves before the sun with its southern not its northern pole foremost, it is easy to conclude that the southern pole is that organ of the earth which serves the purpose of a head: in this respect the geographical globe gives us a direct indication of the above view.

Our earth, as we know, revolves round its sun in cosmic ether i. e. a fluid body — and hence it follows that we must seek our analogy in a liquid environment.

The first which presents itself is naturally the fish, in which we find that, with very few exceptions, the animals of this class have all a sharp triangular projection in front of the head, and a fluke-like tail spreading in all directions. Looking again at our geographical globe, we see in the construction of the continents what we observe in the construction of the fish. All the southern extremities of the southern hemisphere take a sharply

triangular form, with the acute angle to the south, pointing in the direction opposite to that of the world's movement, whereas the continents of the northern hemisphere terminate in a variety of flattened forms, amongst which not a single case of an acute wedge-shaped triangle can be found.

The second analogy which we must seek for in the animal world relates to the organs of movement. The movement of fish is effected by the aid of fins and tail and we shall see that our earth is also possessed of fins in the form of mountains, thanks to which she continually veers about, acquiring thereby a twirling movement in space. We see again, by the globe, that along the whole length of the planet through the two Americas, like two enormous sails or fins, pass the crests of the Cordilleras, starting from a point near the equator and spreading like wings, in one direction along the western side of South America, in the other to the west of the northern continent.

Both these mountain ranges are remarkable from the fact that they are bounded hy uplands on the eastern side, towards which the earth moves, and are precipitous on the western side, that is in the direction from which the earth moves; which shows that in nature there exists a special energy which, breaking into a parallelogram of forces, imparts to the earth a forward movement from West to East. This energy is the warmth of the solar rays.

Till now the scientific world has ascribed a force of attraction to our sun upon which has been established the system of cosmic gravitation. This view, from Newton downwards, has prevailed in the astronomical world, and, as a scientific truth not subject to any question, has been imported into natural science and the text books of cosmography.

The German scientific expedition which, under the presidency of Professor Buchman, has been laboring in Egypt, has come to an opposite conclusion, namely that

the sun diffusing its heat power differentially, through the 12 hours of the day, exercises in Egypt a pressure of a unit of steam power on every metre of the earth's surface; i. e. a pressure equal to 25 poods (900 English pounds) to the square metre. Obviously this pressure is greater towards midday and less towards morning and evening. Egypt was selected for the scene of the labors of this expedition because the Egyptian sky is practically cloudless from year's end to year's end, and rain only falls four or five times in the twelvemonth.

Both ranges of the Cordilleras are also remarkable from the fact that on either being placed along a meridian, the Equator is averted towards the North and South Poles respectively from 23 to 24 degrees, exactly the distance of the sun's ecliptic on the earth.

In view of such striking coincidence it is easy to conclude that the sun furnishes the primary propelling power of earth.

Our globe has however not one but two forward movements of special significance: one round the sun, the other with the general drift of the solar system, a direction lateral to the former.

Turning once more to the geographical globe, we notice that across the continents of Europe and Asia, from the South Western borders of China right to the Spanish shores of the Atlantic, in one long line stretches a range of the loftiest mountains upon earth; — the Himalayan and the Caucasian ranges, the Alps, and finally the Pyrenees. These mountains are also of remarkable construction. In the first place their uplands lie towards the South, their precipices towards the North, and secondly their eastern part is nearer to the Equator, their western to the North Pole, so that regarding the South Pole as a head, these mountains present themselves as an enormous tail, fluke or fin, like the sail of a mill or the blade of a screw, giving a direction to the earth from North to South. i. e. towards the direction of movement of the solar system.

It may well be that the chains of African mountains correspond to this conformation of the Cordilleras, and the mountains passing in a direct line, as we have seen, across Europe and Asia; but, inasmuch as these mountains are but imperfectly known as yet, I shall leave all reference to them till a more favourable time, when more precise scientific researches in the dark continent will have been carried out — a time evidently not now distant.

As a boat under sail rolls from one side to another, as a fish in passing through the water, from time to time turns laterally from side to side, so, precisely, does our earth, in revolving round the sun, fluctuate at the poles. Its fluctuations do not exceed $23^1/_3$ degrees and are called, in the language of physical geography the — e c l e c t i c.

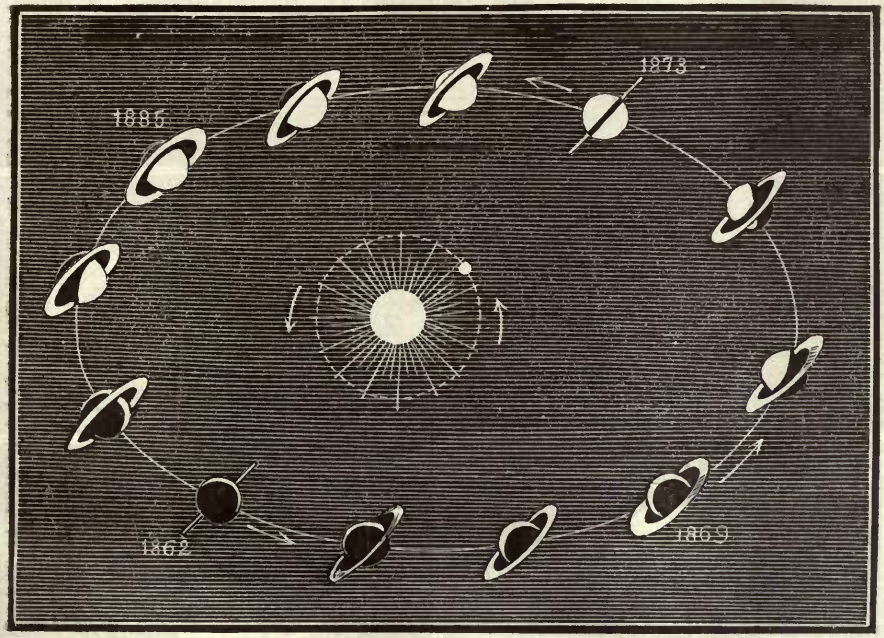
The phenomenon of the electic is explained in physical geography by the fact that the earth moves round the sun not in a direct perpendicular to the Equator, but with an inclination of its axis turning sometimes the North and sometimes the South Pole nearer to the sun, at an extreme rake of $23^1/_3$ degrees.

But this theory is evidently wrong, because together with it, we must admit a third terrestrial movement; that is, one along the line of the Equator, and two in the direction of the North and South Poles. Such phenomena are not to be observed in Nature. No animated creature walks half the year with its head foremost, the other half with its tail. For this would be necessary double sets of organs of propulsion, of directly contrary nature; and this we never see. In this case too, both hemispheres must be of similar construction and uplands and precipices must change places every-half year! It is clear that the ecliptic is the result of the earths roll, and the extent of its fluctuations North and South correspond to the perpendicular of the suns rays falling on the Cordilleras.

That the eclectic of the planets proceeds from their

rolling motion to right and left and not from any fixed slanting of their axes is clearly demonstrated in the case of the planet Saturn.

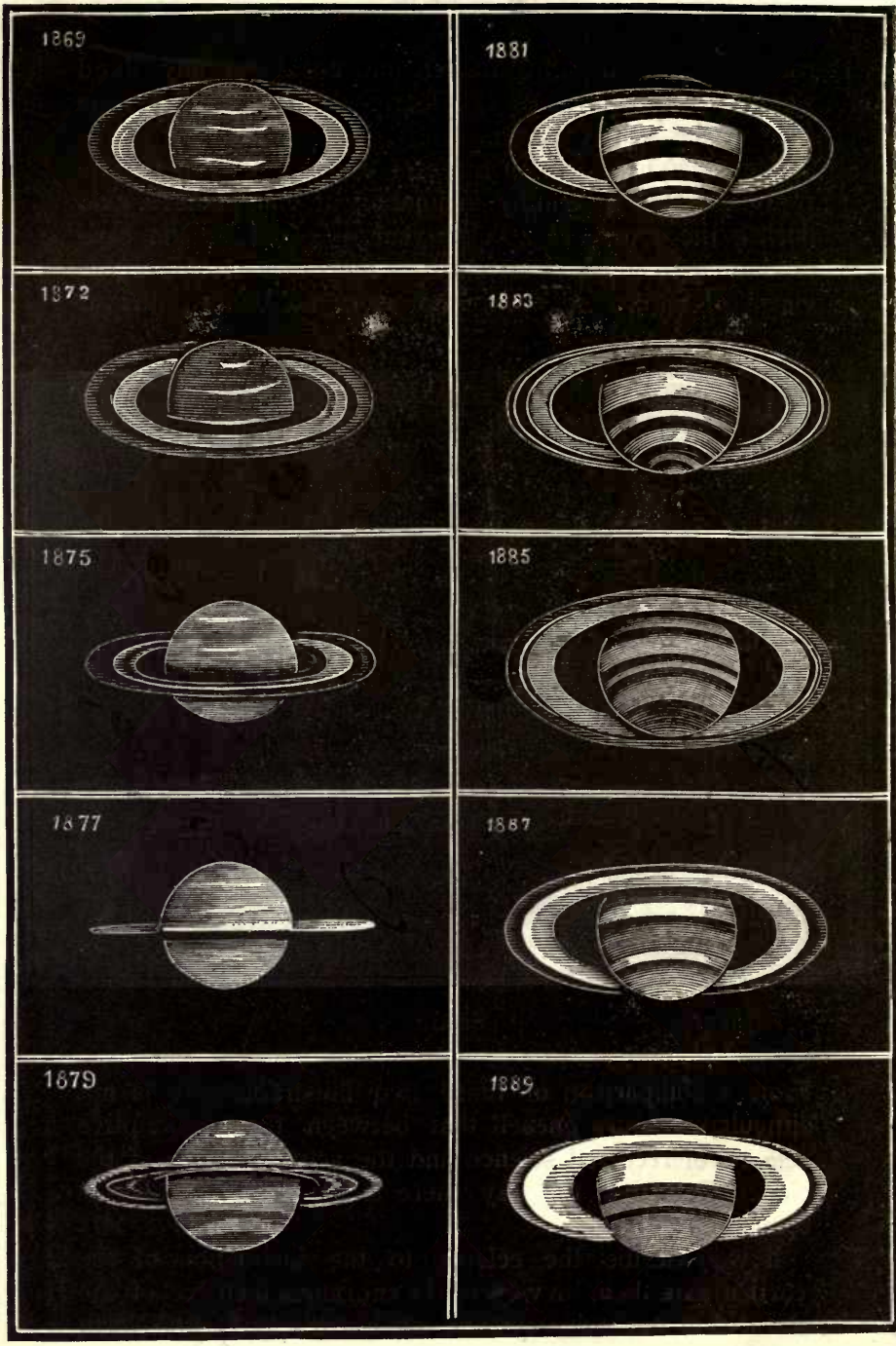
We have here two pictures of Saturn of which one represents the imaginary inclination of that planet's axis during the course of a solar year — equal in the case of Saturn to 30 years on earth, — the other photographic views of Saturn covering the same 30 years interval



Saturn.

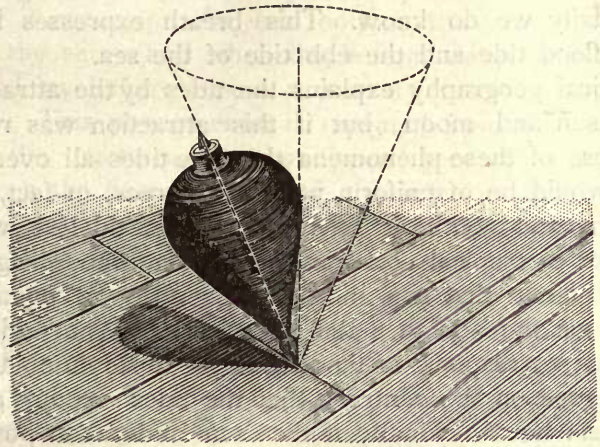
From a comparison of these two illustrations it is not difficult to assure oneself that between the presumptive eclectic of received science and the actual position of the planet Saturn in the sky there is absolutely nothing in common.

If we ascribe the eclectic to the inclination of the earth's axis then, in view of the enormous distance of the stars from our solar system, the Earth's axis at the North



Saturn.
(Photographic views).

and South Poles would necessarily always point towards some one spot in the constellation of the Little Bear in the North and Octant in the South; meanwhile in point of fact throughout the year we find that the northern and Southern constellations confronting the poles change every month. Such a relative position of the constellations speaks eloquently in favor of the supposition that the eclectic of the sun is the result of the earth's rolling from side to side and not of a fixed inclination of the earth's axis. The fact also that the summer solstice begins from the 10th of June (O S) and the winter solstice from the



Humming-top.

10th December, signifying as it does a delay in the earth's movement, can only be accounted for by this rolling of earth from side to side.

Lastly, the most recent researches of the Paris Observatory, published in the pictorial astronomy of Flammarion, explain the process of the earth's diurnal revolution in the following terms: — "In the first place the axis which, continued into space, intersects the heavens at the point called the pole, is not always in one and the same position; it shifts slowly, describing a conic figure, like a humming-top, which, spinning on the floor, inclines its

axis first to one side and, then to the other, and thereby describes a conical figure in the air, or the figure of a funnel, opening out at an angle of 47 degrees.

This it would seem sufficiently explains the ecliptic. We have only to divide the cone of 47 degrees in half, and we obtain in result the movement of the earth's axis on either side of the centre of the cone, $23^1/_2$ degress — that is almost exactly the eclectic of our sun arising from the rolling of the earth.

The third analogy supplied by animal organism is the function of breath. Where the world's mouth is we do not know, but that the earth does breathe regularly twice daily we do know. This breath expresses itself in the flood tide and the ebb tide of the sea.

Physical geography explains the tides by the attraction of the sun and moon, but if this attraction was really the cause of these phenomena then the tides all over the globe would be of uniform power, whereas, in fact, the northern and southern seas are almost tideless, while the tides in tropical countries reach an enormous height*).

If we admit that sun and moon exercise an equal influence on the sea, then the tides must be not uniform but must correspond to the zenith of those luminaries; but we see on the contrary that the tides occupy accurately six hours. Finally if the sun and moon possess this power over the water they must have a similar power over the earth. If the hard ground does not respond to this attraction from its firmness and cohesiveness, at least the dry disintegrated sands of such deserts as the "Gobi" and "Sahara" would rise say a few feet, say a single yard, say even an inch or two. But such a movement, or even any tendency to it, has never been observed, and the only conclusion to which we can possibly come, regarding the tides is, that the earth is breathing, and that during this process the parts of the organism agitated by it advance upon and recede from those parts which remain unmoved.

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[1]) 56 feet.

A clear illustration, indicating and confirming this hypothesis, is supplied by the volcanic eruptions which take place on islands or on continents in places bordering upon the sea. Under the pressure of cosmic movement and the winds, the sea-water in these places penetrates and soaks its way downward till it reaches the heated strata beneath. Coming in contact with the glowing interior its moisture is converted into steam, which forces its way up from under the earth's crust. Yielding to the powerful pressure of this boiling vapour, the surface opens in places and emits the steam. If this takes place in dry ground a simple earthquake is the result, but if it occurs on the sea bottom the water recedes from the shore and when the bottom sinks again to its normal level there ensues a contrary result — the tidal wave. This phenomenon is repeated from time to time, until the subterranean conditions become established between the heated strata of the interior and the sea water penetrating to them, when, though only temporarily, the formation of vapour ceases.

The fourth analogy consists in the living matter of the earth's organism. As in the case of human beings these are parts of the body which can be cut without producing pain or any effort on the part of the organism to replace them, just so also, there are mountains which gradually split up into rocks and remain whole ages in a broken rocky state. On the other hand a wound dealt to any blood-vessel after exciting inflammation and suppuration, heals, and the body returns to its natural healthy state. The very same process takes place in the case of the earth. If you dig a pit in a damp spot you will notice, in the course of nature, consequences closely resembling inflammation and subsequent recovery. In places the ground, becoming oxidized, changes its appearance; the moisture darkens; an immense quantity of animalcule and infusoria appear, vegetation arises, arresting the dust in the air; little by little the hole is supplied with all the elements of the soil and at last levels down and is covered with some pleasant grass.

The water in this case takes the place of human lymph, without which or some equivalent matter, the existence of a living organism is inconceivable.

Amongst physical investigations into the animal life of the earth we must number examination of her heat and magnetism. In reviewing various theories of the formation of the earth I referred to the experiments of Thomson and Forbes. Both these scientists affirm that the temperature of the upper stratum responds to the atmospheric conditions of the day and the year, that at a depth of from 80 to 86 feet we reach the line of unvarying heat, from 9 to 10 degress, below which, descending towards the centre, the temperature rises steadily at the rate of one degree to every 135 feet. Is it not a similar variation, necessarily on a smaller scale which we see in the human body?

As regards the magnetism of the earth, this is shewn by physical research to be her heat power. Experiments with electricity show us that before we can obtain light it is necessary to evolve magnetic currents, which, being converted by artificial mears into alternate currents, furnish electric force, which manifests itself in light and excessive heat.

From the observations of learned travellers we know that on earth there exist two magnetic poles, and three permanent currents directed towards them. All other magnetic currents change their directions, diverging from these straight lines, and sometimes presenting circular movements in various directions over the earth.

The principal lines of magnetism pass one through North and South America, the other two through Europe and Asia. If we consider the mountain chains of the Cordilleras, the Himalayans, the Caucasians, the Alps and the Pyrenees as the fins or organs of movement of the earth then it is easy to see that the Cordilleras present themselves as the backbone of the earth and the other mountain ranges as r i b s.

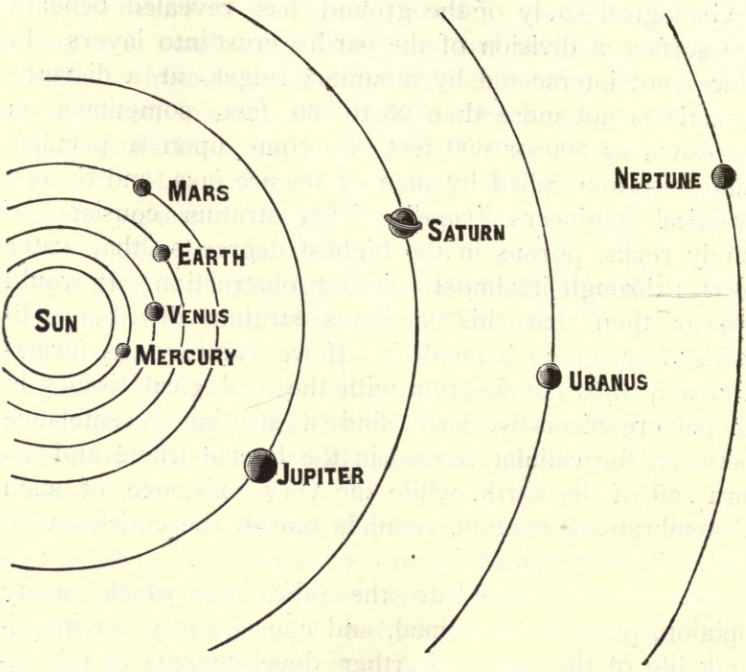
Comparing the circulation of the blood in man and in the bodies of fish with the corresponding function in the

earth, we shall be able to convince ourselves that the three magnetic lines mentioned above answer to the three main divisions of the arterial bood-vessels, the first passing along the spine — i. e. America; the other two being the arteries of the heart and the lungs — Europe and Asia. In this respect the lines of magnetism between the poles answer to the branches of the arterial system in animal bodies, living upon the earth.

Geological study of the ground has revealed beneath the surface a division of the earth's crust into layers In places not intersected by mountain ridges, at a distance sometimes not more than 25 to 30 feet, sometimes as far down as 500 or 600 feet, we come upon a peculiar sandy stratum called by men of science *jura*, and by our practical engineers "*vapp*". This stratum consists of sandy rocks, porous in the highest degree, so that water passes through it almost without obstruction. It would appear then that this laminous stratum distributes liquids everywhere beneath it. If we compare its formation and apparent function with the analogical tissues in animal organisms we shall find a striking resemblance between the cellular tissues in the human frame and the jura soil of the earth, while the very existence of such a membranous stratum, reminds one of the cuticles with their oily secretions.

These, briefly stated are the indications which, in my opinion, point to an animal, and consequently an intelligent life of the earth. Further developments of this vitality and cosmic reason, we shall see still more clearly in the solar system, and in those relations which so closely bind its several orbs — relations so intimate and important that it needs only the withdrawal of a single planet to produce an awful cosmic catastrophe.

Fig. № 1.


MARS
EARTH
SUN
VENUS
MERCURY
JUPITER
SATURN
URANUS
NEPTUNE

The failure of the theory

of

Cosmic Gravitation.

Our school books define the law of gravitation as follows: a free body i. e. a body not confined by any conditions, having received an impetus from the push of any momentary force will continue moving in the given direction in one straight line and at the same rate of movement, by the law of inertia; if however the moving force acts continuously the rate of movement will vary, or the direction will deviate, or both together. By way of proof let us divide some unit of time, say a second, into tiny fractions which we may call, for convenience, "elements" of time. The moving force can now be considered as a succession of momentary forces, impelling the body in question at the beginning of every element, though we must assume that in the intervals between each element the moving force is inactive. The hypothesis is of course inconsistent with the conception of an absolutely continuous force, but the more minute the element of time the more it will approximate to the truth, and, finally, will adequately express the phenomenon we are considering when the fractional element is infinitesimal.

If a free body move in a right line, but at a varying rate, or at a uniform rate but in a curved line, or in a curved line and at a varying rate, it lies under the influence of a continuous force. The planets and comets

move round the sun along curved lines. from whence we can perceive that they lie under the uninterrupted action of some force. Founding our argument upon Kepler's law, it is possible to prove, by a purely mathematical method, without any hypothesis, that this force acts in the direction of a line uniting the centre of the planets and the centre of the sun. At the same time this force evidently attracts the planet towards the sun, and does not repulse it, since in the latter case the planetary orbit would present a convexity toward the sun and not a concavity as in fact. The same remark applies to the satellites; between the planet and its satellite exists a force tending to approximate these bodies. There are also stars revolving round one another, and consequently these also are not excluded from this general law. The primary cause, in consequence of which the heavenly bodies are attracted to one another, is called Universal Gravitation.

By Kepler's law, aided with mathematical reasoning, we can prove that universal gravitation is 1) in direct proportion to the mass of the acting bodies, and 2) in inverse proportion to the square of their distance from one another. These two laws are called Newton's laws, from the name of their discoverer, the celebrated English scientist of the seventeenth century — Sir Isaac Newton.

The story of the discovery of these laws is simply told. The young Englishman, Newton, was sitting one day on a bench in his garden when, suddenly, an apple fell at his feet, and, at the same moment, the moon emerged from behind the clouds. Such very ordinary and natural phenomena might easily have passed without remark, but Newton, struck by them, began to ask himself why the apple should necessarily fall to the ground, and not fly off into space, and why the moon steadily accompanies the earth, and no other globe. An immense number of experiments were tried with falling bodies of various sorts, and, at last, the laws of gravitation were

deduced. These laws are taught as such to the present day, and we will therefore glance at the foundation upon which they rest.

The atmosphere of the earth presses upon its surface with a force of 16 lb. to the square inch, as we clearly see by the quicksilver barometer, and therefore, as Newton's apple possesses no force of resistance to this pressure, where could it be expected to fall but upon the earth? Hence Newtons laws of distance and mass can refer only to the pressure of azote as we shall see afterwards, and not to any principle of gravitation.

In fact the application of this principle to the planetary worlds cannot stand anything like serious criticism, since, by the precisely defined laws of gravitation, the planets of Jupiter and Saturn would long ago have collided and fallen into the sun, a catastrophe for which we are still waiting.

So far as concerns the laws of movement of the planetary orbits it is easy to convince oneself of their inadequacy.

Let us imagine that we have in our hands a benzoin or gas motor, which we attach to an elastic rope fastened at the other end to some point of resistance. We now let out our motor into space. According to the theory of cosmic gravitation as soon as it reaches the extreme limit of resistance of the elastic ligature, the driving power of the motor must also begin to divide into the parallelogram of forces and begin to act within an orbit round its point of fixture. But in fact it comes to a stand and remains motionless, or, if the driving force is too great, the machine breaks under its pressure and will refuse to act.

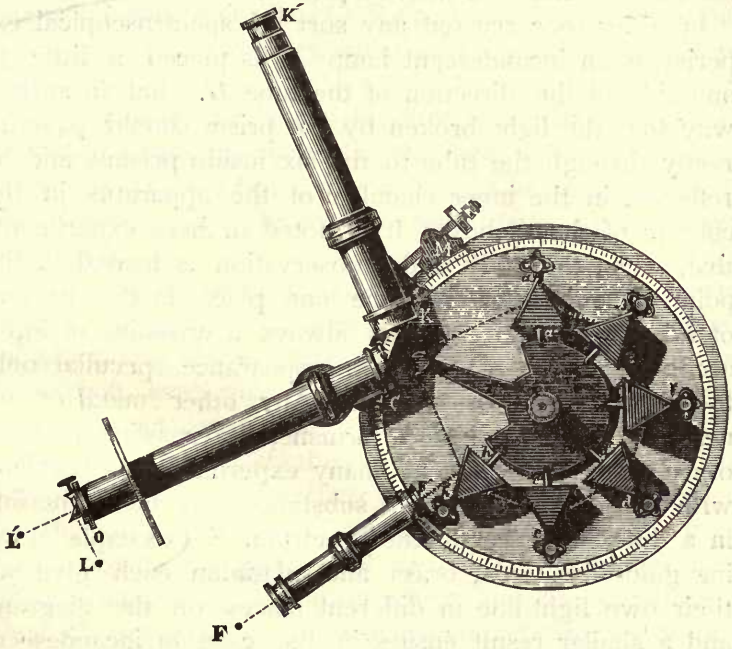
If we take two large bodies and drop them from a great height at the same moment, and at a given distance from one another, they will fall to the earth at precisely, the same distance, whereas, in accordance with Newton's laws, such bodies must approach one another in their descent. In this manner the two fundamental pro-

positions of the law of gravitation remain inoperative when we apply a practical test.

Finally the theory of cosmic gravitation presupposes the exercise of a Force which has, so to speak, flung into the universe, with inconceivable initial momentum and various direction, all the stars and planets and comets and cloud-spots in existence. Myriads of these worlds we see, and we have reason to conclude that myriads more extend themselves in space beyond our ken. These worlds are masses of vast size, in comparison with which the most enormous machines, and even the most tremendous volcanic eruptions are mere points, and we would ask from whence and in what form this unspeakable Force presented itself, and where is it? We cannot detect it anywhere, and the theory of gravitation cannot help us in our search.

The Spectroscope.

Before entering upon any exposition of the Solar system, I consider it indispensable to acquaint the reader with the spectroscope, and the researches which have become possible by its aid.



The Spectroscope.

This Instrument was invented at the beginning of the last century. Its form is the following. In a rounded barrel-chamber closed on all sides are set six prisms,

from *a* to *h*, in such a manner that the broken light of the first prism passes into the second, from the second to the third and so on the light finally passing out into an open space, where it is reflected in a diagram of the seven solar colours. To this diagram, from above is fitted a tube *K* in which the whole colour-diagram is visible, and, below, a microscope is so arranged that, by moving it, the slightest cross-line can be detected in any part of the diagram.

The light outside falls into the interior of this apparatus through another special tube *L'*, furnished at its mouth with a small prism — O. The light entering through this prism and tube is decomposed by all the six above-mentioned internal prisms.

In order to carry out any sort of spectroscopical experiment an incandescent lamp *L* is placed a little to one side of the direction of the tube *L'*., but in such a way that the light broken by the prism should pass directly through the tube to the six inside prisms, and be reflected in the inner chamber of the apparatus in the colours of the rainbow. It is noted in these experiments that, when the body under observation is heated to the point of combustion, in some one place in the diagram of rainbow colours, appears always a crossline of light, according to the place of its appearance, peculiar only to its own metal or mineral. Any other metal or mineral on being so heated, furnishes a crossline in some other place, and however many experiments we conduct with different metals, each substance will throw the line in a different place on the spectrum. For example glowing gold-wire, iron, brass and platinum each give out their own light-line in different places on the diagram, and a similar result ensues in the case of incandescent minerals. If however on the appearance of these light lines we place an electric light behind the incandescent lamp, the light-lines on the spectrum darken, though they remain in their former places. A similar phenomenon is remarked in incandescent metals, when they

reach melting point. These dark lines of absorbed light are called after the name of their discoverer, Professor Frauenhoffer, who first traced their existence in the year 1815.

Experiments conducted with various kinds of gases produced similar Frauenhoffer lines.

When the newly invented spectroscope was first turned upon our sun, scientists were struck by the mass of dark lines which intersected its spectrum. It became apparent that the sun is itself a ball of liquid fire in which all our earthly metals and minerals exist in molten form. A series of systematic spectroscopic researches into the nature of the sun began, under the leadership of Frauenhoffer, after whom, so far as concerns the extent of their labours, came Kirchoff, Bunzen, Brewster and lastly from contemporary scientists Fogel and the Italian savant Sekki.

Frauenhoffer traced and investigated, with the aid of the microscope, as many as 600 lines in the solar spectrum. In Brewster's time as many as 2000 had been discovered, which figure has risen since to no fewer than 5000.

The greatest number of lines of absorption are found in the red stars, after these in the yellow, to the number of which our sun belongs, and the least in the white or blue, such as Sirius on which the lines of hydrogen magnium and natrium are specially prominent.

The chief value of the spectral analysis lies in the unchanging infallible accuracy of the position occupied by the lines of light. Calium, natrium, copper, iron, coal, once having given their line of light in the spectrum never change the place of their line on experiment, though such experiments should be repeated a million times; besides which, combustion on a small scale or a large yields identical results. The lines are always in the same places.

This quality in the Frauenhoffer lines attracted the involuntary attention not only of astronomers but also

of chemists, and both classes of scientists now constantly resort to spectral analysis. If a chemist is unable to dissolve a body into its constituent elements though its unity arouses suspicions, he places a piece of the substance on a platinum plate or wire, heats it in the lamp, and studies the result in the spectroscope. If the burning substance yields a single line it is a chemically homogeneous substance, but if, on the other hand, two or three lines make their appearance, or one main line with branches, the chemical elements of the body are compounded, and those of these lines which coincide with lines already investigated in the solar spectrum, belong to those gases, metals or minerals which scientific men in their researches have already examined.

The very same may be said regarding the starry sky. You catch the light from any star in your spectroscope, it passes through the prism and gives the diagram of Frauenhoffer lines, and you can see at once that this is a sun-star by force of the analysis made beforehand by students of the spectroscope.

Again you catch the ray from another star, which furnishes you the same spectrum, but this time without Frauenhoffer lines; the spectrum is confluent and smooth. What does this signify? It signifies that the star is cold, i. e. a planet merely reflecting the rays of its own sun, or shining in consequence of the action of ozygen on the nitrogen gas of the planet's atmosphere.

Finally this same smooth and confluent spectrum accompanied by the lines of hydrogen and azote, sometimes even the solar spectrum accompanied by the appearance of the same lines, s e p a r a t e l y, present us with the picture of planetary cloud, in the former case representing an already extinct solar system, in the latter such a system on the road to extinction, as we shall see when we come to the investigation of cloud-spots in particular.

Such unerring and invariable accuracy in the phenomena of light and the celestial forces of nature surely

tells us that the spectroscope is the key to the secrets of nature, the v a d e m e c u m of natural science, and the guide to knowledge of cosmic truths and their laws, founded on the phenomenon of light in general and electric light in particular: not the less these cosmic phenomena are, as it were intentionally ignored by the representatives of the school of cosmic gravitation.

I am not the first to appear as an antagonist of this school, and the founder of a new solar system. Others have entered before me on this field. The well known professor of physics, Young, can claim first honours as being the earliest in revolting against the crushing authority of Newton, which stood in the way of progress in optical science, and prevented the establishment of a theory of light on a foundation which we can now see to be thoroughly sound.

Zenger, Faraday and Poloui, working at the problems of atmospherical electricity, and carrying out recent experiments with varied electrical inductions acting on a revolving globe, came to the conclusion that the results achieved in this way would adequately serve to explain the movement of the planets and comets in our solar system, along their orbits. They proposed to substitute for the supposed central law of gravitation, the electric force of the sun. Of course the proposal remained like a voice crying in the wilderness, since it is so much easier to go on holding the beliefs of our fathers and our grandfathers than it is to rack our brains over new experiments, and exert ourselves in the labour of grasping a new cosmic theory.

The Solar System.

The spectral analysis of the sun shows the lines of hydrogen, azote and the gases of metals; besides which, being as it is a burning planet, as combustion without oxygen is inconceivable, we know of the presence also of that gas.

An atmosphere of azote is characteristic of the whole starry world, and only thanks to this envelope, more especially to the pressure which it exerts, the stars preserve their spherical shape. Later on, when I come to speak of the earth's atmosphere, it will be seen what importance azote possesses in the life of the globes, irrespective of their magnitude or position in space.

Experience shows that almost all metals are converted into vapour at a temperature of 3000° C. and inasmuch as the force of heat on the sun is upwards of 10,000° C. the vapours of metals revealed by the solar spectrum appear perfectly natural; not so however the oxygen and hydrogen gases, since the first of these is a product of the vegetable world, and the second of the watery element. As the sun's surface, throughout the historical age of man has been a field of fire, neither water nor vegetable life can exist upon it.

From whence, we ask, could the sun derive these gases? It seems evident, as I shall endeavour to show, that they owe their presence on the sun to the planetary world.

In the Universe as a living organism there is nothing eternal; only the laws by which it moves and by which it is governed are everlasting.

What then do we mean when we speak of the laws of the Universe? What are these laws?

The answer to this question we can only find in nature. Astronomy, the science of cosmic phenomena tells us that all the starry worlds are governed by the law of gravitation; space, as far as the telescope can pierce, is full of stars of different sizes and different sorts — some of them throwing out light-rays of their own, some reflecting the light of others. The former are called suns, and the latter planets. Besides these there exist also comets and cloud-spots.

As all these worlds move in space by general laws, called the scientific laws of cosmic gravitation, I shall confine myself at present to our own solar system, and afterwards we shall pass to a general conclusion regarding the Universe at large.

Our sun is the source of heat and light for the planets surrounding it, of which astronomers have observed eight large — viz. Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune — and as many as 300 small ones, — the last-named circulating in the space between Mars and Jupiter and being known as asteroids.

A very superficial glance at life is enough to shew us what enormous significance the sun possesses for our earth. It is the source of light and warmth; where it shines nature revives, where there is no sun nature perishes. The sun is earth's benefactor; without it we could not enjoy the blessing of our own lives, nor the green landscapes of earth's surface, which sweeten our human existence with their aroma, their freshness, their coolness, their beauty.

But as amongst men so also in nature generally, there is no consequence without a cause, not one phenomenon without a reason for its appearance.

The sun, as I have already said, is a source of light and heat, and all heat, by chemical analysis, is shown to be the result of concealed or open combustion. The burning power of the sun's rays at such an enormous

distance as the earth — a distance of 140 million versts — shows that the sun itself is such a boundless world of furnace flame as utterly surpasses the feeble human imagination. Indeed what conception can we form on earth about this gigantic fire, when we consider that the sun is 1,280,000 times larger than our sphere; and the sun Sirius, visible from our earth in the constellation of the Great Dog, and appearing on our horizon from September to May in the form of a diamond star, is 150 times larger than our sun? Human imagination, trained to a terrestrial scale, refuses to grasp such a phenomenon. And yet these inconceivable giants are in flame, and if so are obviously subject to the chemical process of combustion, which is essentially identical throughout the universe and everywhere alike requires the presence of oxygen for its support. Without oxygen there can be no fire. From whence, then, does our sun derive its supply of oxygen?

We can easily see that this oxygen is furnished by the planetary worlds. Although physical science and astronomy only recognize an atmosphere, properly so called, to a height of 60 versts above the earth, considering the space beyond as being filled with what is called cosmic ether, this ether, had it been really of a nature different from that of air would long since have been subjected to research, since, as our earth moves through this medium at the rate of 28 versts a second, it is not for a moment conceivable that, in the face of such rapidity of movement, this ether should part before the vaporous substance of the atmosphere; it would infallibly permeate this envelope and penetrate to the bowels of the earth, at anyrate in the parts of the globe turned directly towards it. But while we see that such an element, if it exists, must come in contact with our globe, we notice at the same time, that nowhere, even at the greatest elevations, can we trace its presence; hence we are quite justified in assuming that ether is in fact a myth, and that, in the space supposed to be

occupied by it, there really exists a something, binding the sun and the planets in a common whole. Research will also lead us to the further assumption that this something is oxygen, united with hydrogen gas.

Our air consists of four elements: hydrogen, oxygen, nitrogen and carbon. Hydrogen in a pure state is nowhere found in nature, it is found always in combination with oxygen or some other matter. Carbon is a heavy gas and sinks always if we may so speak, to the bottom of atmospherical spaces. Nitrogen is also a heavy gas, and it presses round the earth, by comparison with the other gases, in enormously preponderant mass. Oxygen and especially hydrogen are very light gases; at any rate much lighter than the air, and they posses the following qualities. Oxygen, oxidising as far as possible all nature's elements, changes their original forms, converting them into bodies so widely unlike that it is difficult to discern by any outward sign that the transformed matter so much as contains its original elements. In order to reveal these elements it is necessary to resort to chemical analysis. Hydrogen, although in certain cases it unites with solid and liquid bodies, not the less, does so less frequently: it acts however as a rousing principle throughout nature.

The most interesting question is now to determine how the atmosphere which surrounds the earth is formed. A naturally pure atmosphere presents about 8 parts of hydrogen, 16 parts of oxygen, 76 parts of nitrogen and 1 % of carbon. Carbon is expired in animal breathing; it is a gas highly injurious to animal organisms, but exists in large quantities in various combinations. Peatlands, lime-pits, coal-mines, bogs, decomposing vegetable masses, animal fats furnish it in abundance. Were it not a heavy gas, were it able to free itself from organic combinations and rise in the air, animal life on earth would be unthinkable. Not the less a certain percentage of it constitutes an essential and indispensable element in the earth's atmosphere.

This phenomenon is thus explained: all the vegetation which chiefly supplies our air with oxygen and hydrogen, without nitrogen and salts of silica could not conceivably exist. The oxygen, penetrating the vegetable forms, consumes the decayed parts and escapes to the surface in the form either of oxygen-hydrogen or carbon, while the nitrogen and silica, with the aid of the raising power of hydrogen, renew the decayed matter, and at the same time expanding the vegetable growth by their own contents, strengthen and enlarge the plant or tree. This is the secret of the growth of vegetable forms. Hydrogen and nitrogen are the builders; oxygen the consumer of the perished parts. Instead of these two constructive gases, vegetation gives out hydrogen and oxygen together, and, as these gases are both light, they at once force their way upwards from under the heavier nitrogen around.

Hydrogen is in itself a rousing gas, and its formation is perpetually going on. This accounts for the perpetual ascension of azote to the height of those sixty versts or more which measure the earths atmosphere. Of course the higher we go the less azote we find, and by this is explained the fact that human life becomes impossible above a certain altitude, because man's body, being formed under given conditions of external pressure from the surrounding medium, with the cessation of such pressure opens its pores too widely; blood flows, and the organism suffers complete exhaustion. Exhaustion visibly ensues, though without bleeding, in journeys on high mountains, so that only the natives of mountainous regions, or those who have acquired the faculty by practice, can exercise the same energy on mountain altitudes as near the level of the sea.

Hydrogen in conjunction with oxygen, lifting the heavier azote, remain in atmosphere, in its normal state, approximately in the proportion of $8^{0}/_{0}$ and $16^{0}/_{0}$, notwithstanding the enormous out-put of these-gases going on in the vegetable world. By this means we can determine the natural force of these gases for, by dividing

100 by 24, i. e. the atmospherical mass by the percentage of oxygen hydrogen remaining in it, we arrive at the relative lifting power of the latter, which exceeds the depressing power of the nitrogen and carbon more than four times. By further dividing 100 by 8 we receive in result the lifting power of pure oxygen which we see exceeds the depressing power of nitrogen (azote) twelve and a half times. Inasmuch then as we can detect no foreign elements, entering from without into our atmosphere, it is obvious that solar space is occupied not with the ether which astronomers have imagined, but with planetary oxygen and hydrogen. The question therefore arises as to the significance of this process, whereby cosmic space is so supplied. Why do these gases rise?

I should answer to this that we can see in this phenomenon the return which the planetary worlds render to their sun for its grand and splendid gifts of light and heat. In these mutual functions are expressed the fundamental doctrines of cosmic life.

At this point I shall pause to explain, as far as I can consistently with scientific research, the reason of the movements of particular planets. (See Fig. 1).

As is shown in our illustration the sun revolves in the middle of the planetary orbits, all the planets circling round it. Each planet has its own orbit, i. e. its own circle of distance from the sun, and in the limits of this circle it moves. The following are the distances of these orbits from the sun: for Mercury 53 million versts; Venus, 99 million versts; Earth 140 million; Mars 210; the Asteroids from 300 to 500; Jupiter 720; Saturn 1325; Uranus 2660, and, finally, Neptune 4170,000,000 versts. Such, in mundane measures, are the enormous distances of the planets, and such the sweep of their revolutions in space!

But what is vast for us, is insignificant for Nature herself. From this point of view she seems to be taking ordinary quiet steps; removing her enormous body from

one place to another. Let us take for example the body of a man and compare it with the earth and the sun.

The diameter of the earth is 1719 geographical miles. If we multiply this by 7 that is the number of versts in a mile, we arrive at 12033 versts. The sun's distance from the earth is equal to 140,000,000 versts, which, being divided by 12033, gives us the number of diameters included in this distance of the earth's orbit. We find that this number is 11635. Let us admit, now, that an average man is half an arshin in diameter, and measure out for him 11635 diameters, — equalling 3 versts 439 sazhen and $^1/_2$ arshin[1]); we shall then see that this dizzy distance of 140 million versts is to the earth, comparing the planet with man, a mere trifle of about 4 versts. If however we divide this distance by the sun's diameter — the sun being, as we know, of bulk 1,280,000 times greater than the earth — we have to deal with a distance more than a hundred times greater. By this scale the distance of the orbit is reduced to 17 sazhen (119 feet); in other words it becomes utterly insignificant, and earth appears as the handmaid of the sun, remaining ever near her master. Magnificent distances become minute in this way measured by the scale of the sun's immensity. The remark is applicable of course to the other planets. Infinitely remote as they seem to us, in relation to the sun they are all handmaids within easy hail.

That the sun itself moves in cosmic space is an untoubted fact, proved abundantly by astronomical observations, but, unfortunately, no calculations have established the direct force of this movement. On the other hand the sun's rotatory motion has been successfully calculated and we now know that each complete revolution requires $25^1/_2$ days.

Though there is no exact calculation of the direct movement of the solar system, not the less this movement

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[1]) Approximately 2 miles 1005 yards.

can be roughly determined by the map and the geographical globe.

We have seen that the diameter of the earth is a little more than 12,000 versts. Let us take precisely 12,000 and divide this number by 180 — i. e. the number of degrees of latitude. Each of these degrees is approximately 67 versts. If we consider the mountain ranges stretching from S. E. China to N. W. Spain, — i. e. from the 20-th to the 40-th degree of latitude — as the blade of a screw, moving the earth onward, the inclination of this blade, passing over the firm continents of Asia and Europe, equals a 20-th part of the earth's diameter. Keeping in view the fact that this screw is equal to about a third of the circumference of that latitude of the sphere in which it lies, its whole incline along the whole circumference of the globe in the same latitude — from 20^0 to 40^0 northern latitude — is expressed in 60 degrees. Multiplying 60 by 67 i. e. the length of each degree of diameter, we get 4020 versts, expressing the quantity of space which would be passed through by our globe, if it encountered neither friction nor resistance from any surrounding medium; and as the whole planetary world travels in a direction opposite to the cosmic tide, as is shewn by the cloudspots and comets rolling towards the sun, we must allow half the above 4020 versts to account for the friction of this screw in the cosmic atmosphere, and for the resistance offered by the air to the movement of the earth. The daily progress of earth in the general forward movement of the solar system is, therefore, approximately equal to 2000versts daily.

A more exact calculation can be supplied only by astronomical observations, with which science will undoubtedly sooner or later be enriched.

As far as concerns the movement of the sun round its axis, this rotatory motion is very likely caused by the pressure of oxygen-hydrogen reaching the sun from the planets. We saw that the German scientist Meyer reckons the velocity of the cosmic elements falling into

the sun at 600 kilometres a second, and, as this shower takes place in oxygen-hydrogen, the velocity of the fall of cosmic matter is probably the same as the movement of the oxygen-hydrogen itself. Obviously with such a rate of movement atmospheric blows must take place, corresponding to the pushing or pressing force of the gases; as our sun, then, is only a burning planet, it must possess the same indispensable organs of movement as our earth, organs answering to our mountain ridges and uplands, acting upon which the force of the gases, acting in a parallelogram of forces, can impart to the great globe movement around its pole and movement forward, in common with the planets.

If the sun does not move round its axis so quickly as the planets, this can be explained by the following two considerations. 1) The sun's mass is 550 times greater than the mass of all the planets together; hence the action of its rays may well be far stronger than the counter action of the planetary gases. 2) Secondly, if the sun began to revolve with the same rapidity as the planets it would forge ahead in the cosmic progress and thereby break the harmony of the solar system, which would lead inevitably to its destruction. We see in this existing harmony a cosmic reason, and not the action of any blind law of attraction.

Suppose we imagine that all cosmic space is a fluid in which the cosmic spheres are swimming. By the laws of physics all bodies made to swin in liquid elements must have a rounded form, so that the pressure of the surrounding medium may be uniform on all sides. The starry universe presents a mass of such bodies, from whence we assume that the heavenly bodies move in a cosmic fluid, which astronomers call ether, but which is, in reality, planetary oxygen combined with hydrogen.

The more brilliant the sun, the more perfect; the more perfect the planet the more oxygen it gives out, and vice versa; and as a planet cannot give out oxygen without the light and heat of the sun, nor can the

sun burn brightly without supplies of oxygen, the natural bond between the members of the solar system, which in astronomical parlance is called cosmic gravitation, is clearly in evidence.

I have already said that besides rotatory motion round an axis, the sun moves forward in space. We can see that from analogy. For instance it has been remarked lately that the constellation of Hercules is bearing down with frightful speed upon our earth and if our earth does not change its course, in a few million years a collision must ensue. A similar progress is to be noted in other cases. Our sun, as a star, must follow the same law.

In our picture of the solar system the position of each planet in relation to the sun is clearly shown. The circular movement of these planets is called movement in an orbit, and these orbits according to their remoteness, from the centre, answer to the degree of perfection of the planets themselves. The farther the orbit from, the sun, the more perfect the planet itself; in other words, the more oxygen the planet can produce for the sun's consumption, the more remote its situation. And that the planets do produce oxygen in immense quantity can be noticed at a glance on the earth's surface.

If as is asserted, our atmosphere, as composed of four cardinal gases — oxygen, hydrogen, nitrogen and carbon — was entirely exhausted at a height of sixty versts above the earth's surface, the fires which occur in the forests and the prairies, which burst out sometimes and frequently spread over more than a hundred versts would suffocate all the life around and produce such atmospheric storms as would not only destroy the largest and strongest forest trees, but would break the mountains and granite rocks. No such cases are in evidence. On the contrary settlements have often been surrounded by fires on all sides, but the inhabitants of the places so isolated have experienced not the lack of sufficient oxygen for breathing purposes, but the presence of smoke which lies on the lungs and provokes coughing.

It is easy to observe the rapid consumption of oxygen by combustion. Take a small piece of paper, twist it into a tube and place it in the water, first setting light to the edges : after this cover it with any large jar or other such vessel. In one or two seconds you will see that the oxygen under the jar has been exhausted, the water has been drawn up inside and the fire, without burning down, has gone out. Another still better experiment can be conducted with a small wax candle-end fixed in a walnut. The oxygen, in this case, is almost instantly exhausted.

Imagine then the quantity of oxygen needed to supply a fire spread over a hundred versts! One can say, without hesitation, that the whole atmosphere of the globe would be consumed on a single prairie, or to speak more precisely the 16 % of oxygen contained in it could be so consumed.

Our world is a gigantic solar laboratory. For every sort of chemical combination on the earth or under it, oxygen is needful, and we find in the vegetable out-put of the earth's surface as it were a cosmic factory for the production of this indispensable gas. And yet without hydrogen the spheres would seem like bodies without arms. Other gases covering their surface would conduct themselves quietly, rising and falling according to their heat and nothing more. Hydrogen is the stirring element in life itself, and uniting with oxygen, it throws that gas upward to inconceivable altitudes, rushing with it like a hurricane towards the sun-furnace, to surrender its partner in space for consumptions in the flame, and raising the sun storms to scatter forth on all sides the vitalising solar rays, which in the form of warmth and light flow back to earth and to the other planets to renew by fresh productive energies the same exchange, and to reproduce again ozone. In a word we may call hydrogen the mediator which unites the interests of the central sun and the surrounding planets.

The expansive force of hydrogen is well-known also, upon earth. All explosives, as, for instance, nitro-gly-

cerine, gunpowder, various kinds of dynamite etc. contain this element, whilst the more closely the oxygen element is united with the inflammable constituents the more powerful the explosive. A visible instance of the active force of hydrogen in a more moderate form is also presented in the music of bells and in ocean billows.

Take the former case. When the tongue of the bell strikes the sides, the oxygen which falls under the tongue is rapidly consumed and the hydrogen, released from union with it, shaking the sides of the bell, flies away into space, producing therein a sound-wave, which continues to expand until all the hydrogen has again united with the oxygen in the air around. The vibrations of the bell again, producing friction in the air, consume the oxygen in immediate proximity, and thus, liberating a further quantity of hydrogen, prolong the sound of the stroke until they cease.

The other striking instance of hydrogenic force we see in the case of sea waves raised by the wind. Ocean billows driven by fierce winds reach a height of 35 yards [1]), or more than a hundred feet. In order to raise water to such a height by a steady force, an energy of one thousand poods (36,000 lb) to the cubic sazhen of elevation would be required. No winds possess such power on earth but the phenomenon is otherwise explained. The air coming in contact with the surface of the water, under force and pressure of the wind, consumes the oxygen by this contact, and the released hydrogen with an explosion escaping from under the local pressure, raises the moving waters to a great height, and, reaching the crest of the waves beats and scatters them in foam. At such times it is only necessary to pour oil on the water to reduce these waves to just the limits defined by our celebrated Russian scholar and professor, Ostrogradsky, in his theory of wave formation and marine tides.

It would seem in pouring oil on the water that one would increase not diminish the raising power of the

[1]) 15 sazhen.

wind, oil being lighter than water; in fact however the result is quite the opposite of this presumptive probability, and the explanation is to be sought in the chemical analysis of oil. Oil is a combination in which is the element of carbon, but no hydrogen. Consequently, though the force of the wind remains the same, the explosive emission of hydrogen from the surface of the sea ceases, and only the hydrogen freed in the air by its concussion breaks away into space with equal force. The water, defended by its envelope of oil, falls to exactly the extent answering to the real pressure of the wind, minus the previous explosive power of the hydrogen liberated from the waves.

The following details of explosive combinations of hydrogen gas will serve as a visible proof of the force of its action in the nature of things.

HYDROGEN EXPLOSIVES.

Gunpowder (old) $2\,KNO_3 + SH_2 + 3\,C.$
„ (contemporary): —
Nitroglycerine $C_3H_5\ (NO_3)\ 3 + CH_3OH.$
Pyroxeline $C_{24}H_{29}O_3\ (NO_3)\ 11 + CH_3OH.$
Dynamite $C_3H_5\ (NO_3)\ 3$ with additional matter.
Fulminating Mercury $NH_3Hg.$
„ Silver (Bertholet) $NH_2Ag.$
„ „ (nitrogenic) $NH_3Ag.$
Nitroglycerine $C_3H_5\ (NO_3)\ 3.$
Explosive pyroxeline $C_{24}H_{29}O_3\ (NO_3)\ 11.$
Pyroxeline (collodine) $C_{24}H_{30}O_{10}\ (NO_3)\ 10.$
Melinite $C_6H_2\ (NO_3)\ 3 + NO.$

In a word the stronger the explosive the larger the constituent element of hydrogen, and one can affirm, with confidence, that if only the chemical combination H_{100} could be discovered, no limit could be set to such a force on earth, and the inventor of such compound would receive the homage of all countries in the world, for putting an end to the tyrannies of war.

Let us glance now at the manner in which the inter change of vital cosmic principles is carried out. All the planets move round the sun, but not in one simple line of direction; they acquire three motions: — one forward in space together with the sun itself, a second round the sun, a third round their own axis.

Moving round their own axes the planets leave behind them in their course a long ribbon of oxygen which is rapidly born by hydrogen gas to the sun, so that the planets present themselves from this point of view as reels of oxygen, perpetually unwinding their treasure for the sun's use, whilst the sun in its turn, rotating, furnishes its worlds with heat.

The relation of the oxygen produced and furnished by each planet to the amonnt of solar heat, maintaining each globe in its own orbit, is the reason of the cosmic spheres, called, in the language of astronomy, the law of cosmic gravitation.

I have already remarked that the brightness of the sun is its perfection, while the quantity of oxygen distilled by a planet is equally a mark of development. The factors determining the perfection of the sun appear to be: a) its absolute size; b) the flood of planetary oxygen; c) the supply of comets drifting through space; while the perfection of the planets is determined by a) the radiant energy of the sun; b) the supply of cosmic matter, and c) the development of heat and energy on the planets themselves. According to these three things the vital share of a planet in the cosmic scheme is dependent upon its out-put of oxygen-hydrogen.

On analysing our solar system by means of astronomical observations we find the fullest confirmation of this theory. Such observations show that the larger planets are those farthest from the sun, the smallest those which revolve in the smallest orbits. At the same time the remoter planets have more satellites and rotate more swiftly. (Sec. Table of the Solar System).

		Size in comparison with the earth.	Distance from the sun.
Sun.		1280000 times larger.	—
Interior planets.	Mercury.	18 times smaller.	53 million verst
	Venus.	Almost the same size.	99 million verst
Earth.		—	140 million vers
Exterior planets.	Mars.	$6^1/_2$ times smaller.	210 million vers
	Small planets (Asteroids).		300—500 millio versts.
	Jupiter.	1300 times larger.	720 million vers
	Saturn.	864 times larger.	1325 million vers
	Uranus.	75 times larger.	2660 million vers
	Neptune.	85 times larger.	4170 million vers

ne occupied in volution round the sun.	Time occupied in revolution round axis.	Number of Satellites.
—	25½ days.	—
88 days.	44 hours 5 minutes.	0
7½ months	23 hours 21 minutes.	0
365¼ days.	24 hours.	1
ear 11 months.	24 hours 37 minutes.	3
m 3 to 6 years.	--	0
12 years.	9 hours 55 minutes.	7[1])
30 years.	10 hours 15 minutes.	9[2]) and a ring.
84 years.	Unknown.	4
165 years.	Unknown.	1

rom observations at the Lick Observatory.
rom observattons at the Cambridge Observatory.

Though the table we furnish does not present a regularly graduated arithmetical progression, nature seldom presents us with precise applications of general rules, and we must take her as she is. The leading principle of solar arrangement is clear enough. Mercury and Venus, whose orbits lie inside the orbit of the earth, appear like pigmies in comparison with Jupiter and Saturn.

If cosmic movement was limited to solar systems such as I have sketched, it would soon undergo a change without attaining the maximum results of life. The sun utilizing the planetary oxygen would burn itself out by degrees, becoming ever smaller and smaller. The diminishing solar radiance would chill the planets. The whole system, deprived of circulation, would perish. But such is not its cosmic destiny!

The sun in fulfilling its function is nursing and tending creatures like itself, and planets only attain their ultimate perfection when they become suns. This is the idea of the Cosmos!

The process is, to us, enormously prolonged, and human life is too brief for effectual research; but scientific investigation continues from age to age, and perhaps the time will come when some favourites of destiny will live to witness the grand transfiguration of a planet into a sun. Meanwhile let us now modestly occupy ourselves with the study of the comets and the moon.

The Moon.

Just as the sun possesses in the planets its satellites, so also the majority of the planets have satellites of their own. Of such minor orbs the telescope has revealed 3 attached to Mars 5 to Jupiter, 8 to Saturn *) 4 to Uranus, 1 to Neptune, and finally one, belonging to our own earth, is sufficiently visible to the naked eye. This last-named is our moon.

As the number of a planet's satellites is in direct proportion to its distance from the sun we must suppose that Uranus and Neptune possess more satellites than are yet known to astronomy, but that, owing to their great distance from our earth they evade scientific research. The sphere of such research is however widening. Till 1892 only 4 moons had been discovered round Jupiter, but in that year a fifth was added. This was closer to its planet than the others and was only revealed accidentally thanks to an eclipse of Jupiter by Mars. Jupiter is separated from the earth by 580.000,000 versts, and it took thousands of years to disclose its fifth satellite; but Neptune is distant from us 4,030.000,000 versts, and it is scarcely to be wondered at that astronomical investigation directed across such an inconceivable interval should have failed to detect multitudes of bodies swimming in that vast space.

For a long time the question, What is the moon? constituted the pium desiderium of the learned astro-

*) A ninth and more remote satellite of this planet was discovered according to an announcement of the Lick Observatory in 1904.

nomical world. The telescopes of our observatories were directed towards this satellite hundreds of thousands of times, and every time yielded only partial and local results. We learned that it revolves round our globe in an elliptical orbit, and that it does not revolve upon its own axis like the earth, but occupies in each such revolution the same time it takes to complete its orbit round the earth. The moon we also found was of volcanic origin, possessing lakes and mountains, but destitute of air and consequently without vegetable life. For the rest it moves with the same side always towards our planet so that its physiognomy presents no changes. But what the moon is in itself, why it does not revolve around its own axis in the same way as our earth, why it presents always one aspect to its planet what its influence may be, or how it is acted upon by earth — these are points as to which the scientific world remained in darkness. Physical geography it is true admits certain hypotheses regarding lunar tides, but all such theories are of most hyperbolical origin, as I shall try to explain in another place.

In an earlier part of this work, speaking of the influence of the sun on the earth and the surrounding planetary world, I said: Where there is a sun, natures revives; where there is no sun she perishes. If we regard the earth as a rotating sphere with one side turned towards the sun and the other towards infinite space, judging by the above axiom one half of the globe must be daily in a dying and the other half in a reviving condition, and thus the sun, expending its radiate energy on the revival of the perishing life of earth, would receive either nothing or at any rate infinitesimal quantities of nourishment in return, and finally the too prolonged absence of solar rays at the poles would result in the destruction of all vegetation, which in its turn would react injuriously on the perfection of the planet.

In order that the flora of the earth should not be thus endangered, nature has furnished the planets with their satellites and earth among them with its moon. The

action of the satellites upon their planets is electrifying; they are neither more nor less than colossal magnets, magnetised by the sun, that is to say by its heat, and as the action of every magnet appears only at its poles the reason of the moon's remaining always in one fixed position towards the earth, with one side or rather pole always visible is perfectly explained. Thus, if we admit that the sun in warming one side of the earth charges it with positive electricity, the opposite side must supply the negative pole, and as the attractive force of magnets only operates between opposite poles still another reason appears why our moon only shines after the sun sets. In other words all the movements of the moon round the earth, proceed on the opposite side from the sun.

I have already said that the action of the moon is electrifying, and this process we may say is allied to the lymphatic nourishment of the human body in sleep. Imagine for a moment a vegetable world exposed to the rays of the sun incessantly. All the energy of such a world would be devoted to the production of oxygen for the sun and vegetation in forming this complicated product would draw up the moisture from the earth without supplying the loss and besides that being always at work would have no opportunity for renewing its exhausted parts. At last would appear a dried up field useless alike for earth or sun, as indeed we see sometimes in nature when the sun scorches some locality too fiercely and leaves it unrefreshed by vivifying moisture. But notice the saving influence of night! The envelope of the earth's crust is heated, and by a law of physics all heated bodies rise. A stream of gaseous heated matter struggles up to the earth's surface and amongst such matter the beneficent ammonia compounds so useful to the life of plants, while in the air occur also atmospherical changes from a like cause — the atmosphere rising and carrying with it indispensable supplies of nitrogen. Thus vegetable renovation goes on both below and above the ground. Vegetation receives the silica, ammonia and

moisture it needs, and the nitrogen, sustained by the motion of the air, nourishes and gives strength to the vegetable organism. And all this is effected by the electrifying power of our moon.

Experiments testing the influence of electricity on vegetation have been begun but recently. Until the discoveries of Yablochkoff and Edison, though there was the Drummond light and, incandescence of platinum wire had been produced by galvanism, experiment had only proved the latent presence of a power in nature which without fire could generate both light and heat. The inconvenience of the Drummond light lay in the circumstance that it demanded special technical apparatus for the adjustment of the burning charcoal points, and moreover the light itself burned fitfully; whilst experiments with incandescent wires went no further than the proof of the extraordinary heat of electricity which could fuse platinum, a substance which up to the application of this force had defied all attempts to melt it. As to the general application of electricity as a source of agreeable light nobody in those times ever dreamt of it.

But as in human lives an accident will change the whole current of a man's ideas and even the course of life itself, so also in science one successful experiment will sometimes lead to a succession of discoveries of highest importance and utility. Yablochkoff's system of electric lighting is in reality a simplification of Drummond's. Before its introduction the charcoal points were always directed perpendicularly towards one another. To this inventor the idea occured to place the charcoals parallel to one another. The result proved in every sense of the word brilliant, and at once the system of "Yablochkoff lighting" sprang into existence.

When the manager of the Hermitage Garden in Moscow, Lentovsky succeeded in arranging an artificial electric moon on the stage, the impression made on the public at the time was tremendous. The public went into raptures over this novel effect; found that Lentowsky's

moon was as beautiful and as bright as the real moon, or even better. The press was also eloquent in its praise. But by degrees, of course, this luminary was forgotten. Meanwhile at the present time this lantern-moon is proving the germinal ray of electric science. Did Lentovsky foresee this, I wonder when he reared his moon over the stage?

While Yablochkoff was striving to improve the Drummond light, the American Edison devoted himself to the practical application of electric light by means of incandescent wire. I remarked before that originally in text-books of physics electric incandescent wires were employed as an illustration of combustion by galvanic current, consequently we see that Edison had to find a system of applying electricity in such a way that the wire subjected to its current should glow without combustion. The problem was more difficult than that which Yablochkoff had to solve but by various means, the application of different systems of electricity, the preparation of wires from charcoal, by means of lessened inductors and thickened wires, the difficulties were overcome and a system of prolonged incandescence became established. Edison's system does not abolish the process of combustion but defers it remotely, so that a wire can sustain a thousand hours, more or less, of incandescent heat. But here I must explain that though the first experiments with the Drummond light and incandescent wire were made with galvanic currents, as the later experiments proved that all the visible qualities of electric phenomena by galvanic currents appeared also in experiments with currents received from powerful magnets, both the celebrated electricians of whom I have been speaking made wide use of a system of magnetization easily managed by the aid of steam electro-motors. Edison in his experiments and discoveries utilized both systems, and event the Volt arc.

For the bulk of spectators Lentovsky's electric moon was a pleasing panorama or picture which soon dropped

out of memory, but for the more thoughtful, it supplied matter for reflection. On the appearance of practical applied electricity, many students strove to trace more fully the properties and functions of electricity in nature. Twenty-five years ago, now, all over Europe began a series of efforts to apply electricity for the production of all sorts of desirable changes in organic and inorganic bodies. Experiments were tried with milk, with water, with wine, with metals, in a word with every conceivable object.

As this electric analysis of various products is irrelevant to the matter of cosmic movement I must put it aside and direct the readers attention only to those observations which relate to vegetation.

If we completely isolate any vegetable growth from the sunlight and leave it all the other natural conditions of its existence, the growth in question will lose its colour, wither and shrivel and die. But if instead of daylight you supply the plant with electric light, the plant will not only live, but will renew its functions as in nature, but it will yield either no fruit or but very poor sort. Such experiments have received frequent confirmation, but have not hitherto led to any systematic inferences.

In the year 1892, in St. Petersburg, Professor Norkyevich Yodko gave the first demonstrations of his experimental researches into the influence of atmospherical electricity on vegetation. These experiments of this scientist were of pre-eminent interest, because they were conducted with atmospherical electricity and not with artificially produced. I will try briefly to explain their substance.

Norkyevich Yodko is an agricultural landowner and squire of Western Russia. For his experiment he took one of his own fields of uniform ground and soil and divided it in half. Both halves he sowed with corn-grain, equally. After this he drove in at both ends of one half a number of wooden posts, and stretched between, ac-

ross the field, a number of iron wires which were fastened down into the soil, one end to a copper the other to a zinc plate, thus supplying a net of parallel wires throughout that half. This net formed of course a weak galvanic battery which collected the electricity in the atmosphere.

The experiment led to the following result. The part of the field intersected by the wires produced abundance of root and green growth, and the other part appeared comparatively starved. Bearing in mind that oxygen-hydrogen is chiefly distilled by the green growth of vegetation, and that root is the foundation of vegetable life, the conviction arises that the more atmospherical electricity there is on earth the more vigorous the vegetation and hence the more abundant the production of oxygen-hydrogen for the sun's supply.

In France electrical experiments with plants were conducted by the scientists. Bartelot and Gotier. In the year 1882 the latter planted in flower pots various sorts of flowers. The poles terminating a chain of thermo-electrical elements HOe. were buried in the mould of some of these pots. The result showed that the plants through whose soil the electric current passed grew with amazing rapidity. In six weeks they attained an extraordinary development, in size and weight doubling the proportions reached by those plants to which no electricity had been applied.

Looking more closely at the solar system we can now see that the sun exploits the planetary world, but, at the same time strives to maintain its existence. By day it takes its supply of vital energy in the form of oxygen-hydrogen, but at night, by means of lunar electricity, it repairs the organic injuries and losses of earth's vegetation sustained during the day's work. The experience of natural science shows that flowers produce no oxygen, either in the day or in the night. There is nothing then to surprise us in the fact, shown by Norkyevich-Yodko's experiments, that the sun as it were ignores this pro-

ductive element in plant-life as something indifferent and unimportant, and that flowers depend therefore more exclusively than foliage upon manures, a fact already long since remarked by horticulturists.

From recent times many scientists have begun to resort to the spectral analysis when investigating cosmic phenomena of light. By help of the spectrum, which divides the star light into its constituent parts, the possibility of comparing these lights with our own earthly lights, produced by incandescence and combustion of various metals and gases, has been arrived at. Thus the coincidence of the light shed by earthly matter with some rays falling from a planet and received into the spectrum justifies us in assuming that this ray is derived from the combustion on the planet in question of the same matter. But when we submit the rays of real moonlight, and the rays of an electric lamp of Yablochkoff's system in the chamber of the spectroscope we find that the results are perfectly identical. Inasmuch then as Yablochkoff's electric lantern is the product of magnetism, it is evident that moonlight is also a magnetic phenomenon. The latest experiments with the Yablochkoff lamp in America have borne striking witness to its vitalising influence. Plants placed in a room lighted by these lamps not only survived, but grew rapidly, and developed abundant leafage, a firm strong stem, and stoutly burched roots. Such evidence proves very clearly that electric light in nature is a vital moving power, and the moon, presenting as it does a colossal electric lamp, has therefore a very obvious aim and function.

Experiments with electric light are carried out also in our St. Petersburg Imperial Botanical Gardens, and have afforded excellent proof of the salutary effects of this light on vegetable growth. They were more particularly successful in the case of araoukaria, a tree having the general form of a luxuriant green yew. Generally, whether in conservatories or in the open air, this tree grows with unequal foliage, three sides developing a denser

and fuller growth than the fourth, facing north; under the influence of electric light, however this tendency disappeared and the plant grew equally on all four sides.

Without lunar light as a product of solar heat, the very existence of a vegetable kingdom would become impossible in the night time. As a human being fortifies his body for further effort in the day by sleep, so our flora, as I said before, recruits and renews its powers and exhausted parts in the hours of the night. We see in this the grand function of the moon.

Obviously this view of lunar activity is utterly contrary to the opinions of our physical geographers, since the marine tides have nothing to do with the earths vegetation; nevertheless my theory is founded on scientific research in the vegetable kingdom, while the current theory of the tides is a mere groundless hypothesis, which also it is likely to remain. For, as I have pointed out' if the moon raises the water to a height of ten or more sazhen, why does it not draw the solid surface of the earth, if only an arshin? Every one knows that it has no such influence. The whole theory of lunar magnetism acting on the sea is a mere hyperbolical dogma of a science, which baulked of an adequate explanation, has come to a dead stand before a phenomenon which it is not able to account for.

Further on, when I come to speak of our earth as a reasonable acting member of the solar system and a living organism, I shall return to this inexplicable phenomenon. Meanwhile we may note that the moment we analyse the general picture of planetary and solar life we cannot help remarking the inadequacy of the exposition founded on the supposed attraction of the moon. Our earth has only one moon and two flood and two ebb tides per diem. Mars has 3 moons, so must have on the same principle six flood and six ebb tides; Jupiter must have ten, and Saturn eighteen. But the day on Jupiter and Saturn is two and a half times shorter

than on earth. so that in the 24 hours of our day those planets must experience 25 and 45 tides.

In the nature of the heavenly orbs all the phenomena take place calmly and in established order; and we can study them at our leisure. In the phenomenon of the sea tides, the flood tide is always accompanied by tidal waves. Under existing conditions these risings of the water being gradual and quiet do no harm, and threaten no dangers either to mariners on the water or to dwellers on the shore; but if they occurred 25 or 45 times a day, the sea would become a seething cauldron upon the surface of which no ship could float, and in the waters of which no fish could live. And such destructive phenomena on Jupiter and Saturn, in consequence of their greater size, would be more awful than on earth.

The Comet World.

In the preceding diagram we saw the solar system presented perpendicularly to the orbits of the planets revolving round their sun; let us now turn this system and look at it from the side, bearing in mind that each planet presents as it were a reel of oxygen-hydrogen. We know, from astronomical and common observation, that the planets between the sun and the earth are visible to N. E. and N. W. while the external planets are seen to ihe S. E., S., and S. W.; thus the orbit of each planet is laid out in the form of a line in such a way that the perpendiculars produced from the sides of these lines towards the sun present cones so arranged that the cone of each separate planet lies within the cone formed by its neighbour nearer to the sun. (see Fig. 2).

This picture brings to mind a sort of net or web the rings of which — i. e. the planetary orbits — become more frequent as they approach the centre.

What, we ask, is the meaning of this arrangement?

On further acquaintance with the movements of the comets and cloudspots we find that the direction of such as fall into our solar system passes straight towards the centre of the planetary cone.

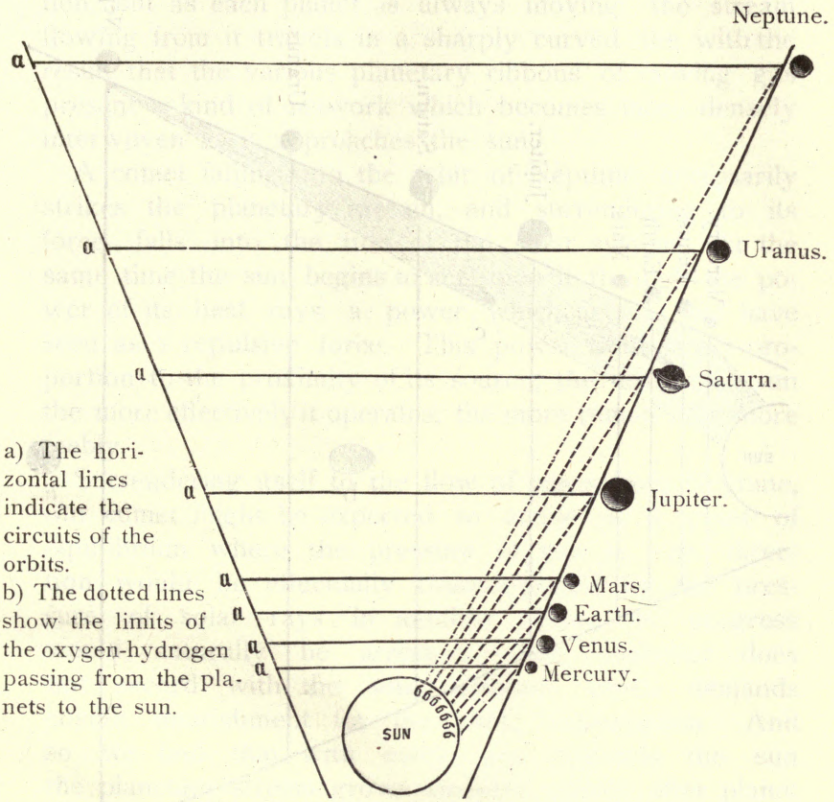
All the comets and cloud-masses are composed of cosmic elements, borne, like shoals of little fish, through cosmic space, and, as these elements and groups of elements are but loosely united, they easily yield to the influence of larger bodies which meet them in their course.

The sun, as I said, is a burning planet. The oxygen which it requires for maintaining combustion it receives from its own planets; but if its furnace fires were not supplied with fuel from outside they would of course burn out, and the sun would become itself a cloudspot. But nature in her wisdom has provided for this. To maintain the life of the sun she has supplied worlds of cosmic nourishment in the form of comets. At the same time look at the marvellous ingenuity revealed by the method in which this solar food is caught!

If the sun remained alone, its hot rays would rather repulse than attract approaching matter, the force exercised by these rays being as it is a force of repulsion and not of attraction. In the calm movement of the worlds the comets would float past the sun, and only those of them whose course lay in a straight line with the sun's might collide with it, and, yield their substance as a prey. But the sun is not alone. It is surrounded with its thousands of solar agents, and taking Neptune as the remotest at a distance of 4,170 million versts, we have a circle the diameter of which is no less than 8340 million versts, while the circumference involved is $8340000000 \times {}^{22}/_{7}$ — i. e. 26,211,428,573 versts. Of such enormous dimensions it the network shown in our second diagram! Evidently all that is seized within the expansive limits of this net serves as solar food, or as food for the sun's satellites. This explains the appearance of œrolites on our earth, it accounts for the formation of the ring round Saturn, while Jupiter the most, powerful of the planets has evident ly a special in fluence since comets passing its orbits are visibly affected and their course is not infrequently diverted. Diagram 3. presents a view of the comets in their course.

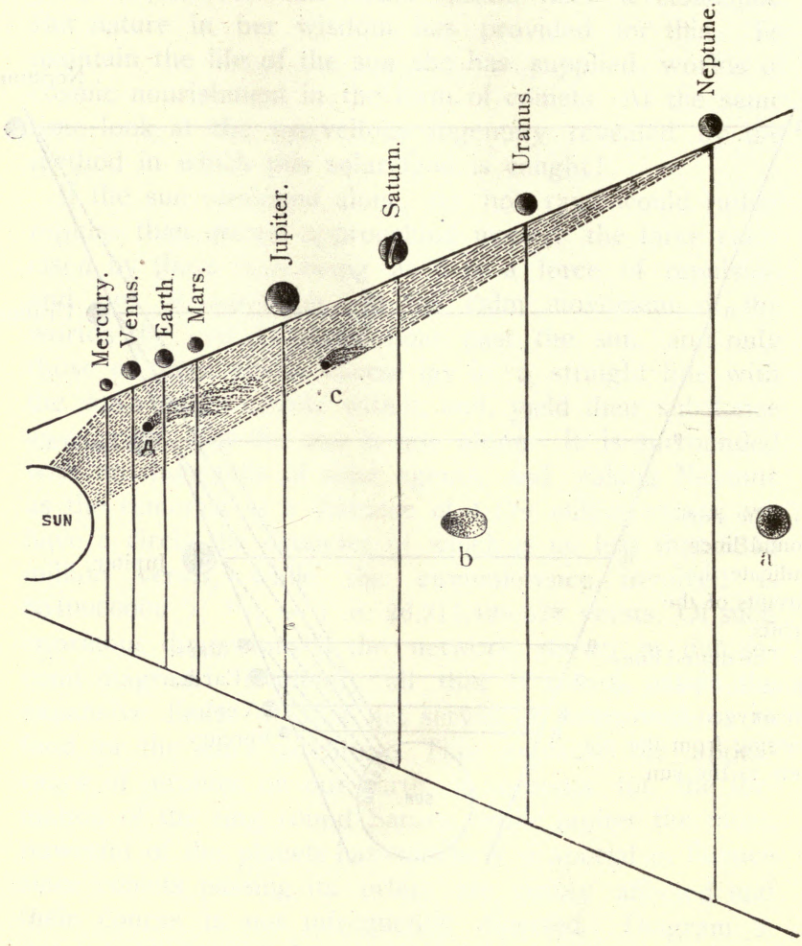
As soon as any comet or cloudspot falls within the orbit of any of the planets it at once changes its drift and surrenders to the stream of cosmic gas flowing towards the disc of the sun. It is very easy to under-

Fig. № 2.



a) The horizontal lines indicate the circuits of the orbits.
b) The dotted lines show the limits of the oxygen-hydrogen passing from the planets to the sun.

Fig. № 3.



a) Cloudspot or comet beyond the limits of the solar system.
b) The same cloudspot inside those limits.
c) The same cloudspot in touch with the stream of oxo-hydrogen flowing from the planets to the sun.
d) The same cloudspot or comet with long tail in the middle of the planetary stream.

stand this change when we remember that each planet, in fulfilment of its vital function is discharging its maximum of oxo-hydrogen, and that this freed gas is hastening with tremendous velocity towards its goal. This solar current might be directly perpendicular to the solar disc if the planets remained without changing their position, but as each planet is always moving, the stream flowing from it travels in a sharply curved line with the result that the various planetary ribbons of moving gas present a kind of network which becomes more densely interwoven as it approaches the sun.

A comet falling into the orbit of Neptune necessarily strikes the planetary stream, and surrendering to its force, falls into the tide of the solar system. At the same time the sun begins to act upon it through the power of its heat rays, a power which acts as we have seen as a repulsive force. This power is in direct proportion to the proximity of its source; the nearer the sun the more effectively it operates, the more remote, the more feebly.

Surrendering itself to the flow of gases from Neptune, our comet might be expected to arrive at a point of equilibrium where the pressure of gas in one direction would be effectually counter-poised by the pressure of solar rays in another. Here its progress would naturally be arrested. This however does not accord with the solar scheme which demands cosmic nourishment for the sun's consumption. And so we find that with every step towards the sun the planetary stream grows stronger, planet after planet lending its quota to the mass, and so increasing the general drift as to render the comet's escape impossible Driven by the force of these gases right on to the solar furnace, the comet body leaves for combustion a mass of its material, while the remainder, under the driving influence of radiant solar heat, is thrown out into space outside the orbits of the planets, where, resigning itself once more to the general cosmic tide, it again drifts along

until it falls into another solar system, the process repeating itself as long as any of the substance of the comet remains.

From remote times astronomers have observed multitudes of comets, have followed their movements and by their parabolic lines, which could be measured, formed the plan of their ellipse, the path of which occupied, by their calculations, tens and in cases even hundreds of years. These calculations were rarely successful. In the great majority of instances these comets passed on their way leaving their imaginory parabolical lines and ellipses on the astronomical charts without troubling to fulfil these astronomical predictions. This fact explains itself very simply. A comet having passed tover the solar disc can never receive a contrary course, because *cosmic life is an eternal forward movement.* If then certain comets seemed to justify astronomical prophecy, this is merely owing to a scientific blunder, founded on the confusion of a comet body which happened by coincidence to appear at a given time, with some other comet, the supposed ellipse of which had led astronomers to foretell its reappearance at that time.

Cloudspots and comets pass across the solar disc every year. In 1894 for example, no fewer than three comets and four cloudspots were remarked. The fact that some single comet shoald now and then pursue the course of some other comet which passed through our system ten. twenty or a hundred years ago can hardly excite surprise. From the year 1 of the Christian Era to the present time more than 4000 comets and cloudspots have passed towards the sun. Two hundred and eighty of these have been examined tkrough the telescope and their supposed orbits have been defined, but of such calculations only 12 received apparent confirmation; the rest were complete failures, the comets whose reappearance was foretold disappearing finally. The ridiculously small percentage of cases in which comets have seemed to reappear and justify predictions, speaks incontrovertibly in favour of the idea that such instances present merely an accidental coincidence.

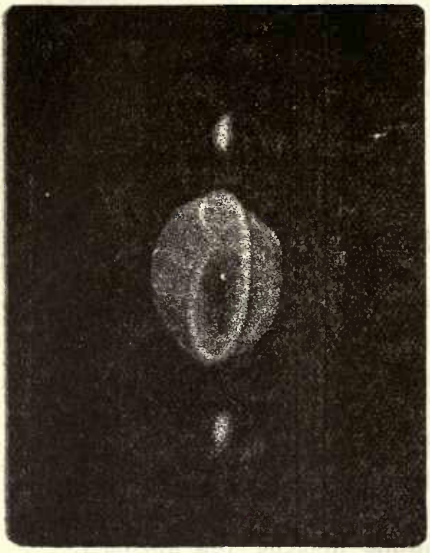
Cloudspots.

Cloudspots differ very widely. There are some which present the appearance of a mass of brilliant points; others which look like an ink-smudge, which, forcibly struck, has scattered sputtering lines in all directions; still others take the form of a firework rocket.

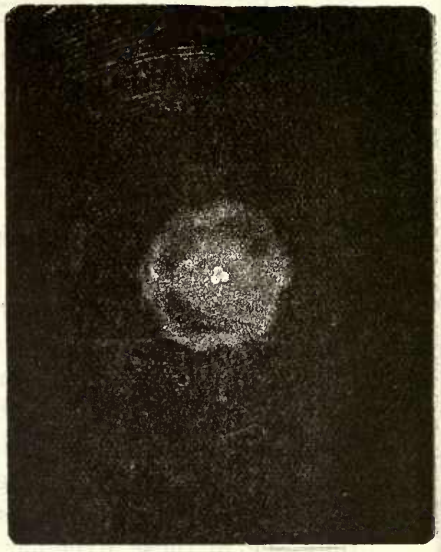
Many scientists, studying these spots, have come to the conclusion that the cosmos is still incomplete, and they see in these irregular shining masses the germs of future planets. But as not one cloudspot ever presents anything like an organised system, as these masses pass across the solar disc in the middle of the planetary orbits, and as some of their forms, as for instance the form of a discharged rocket, are the forms of bodies tending to decomposition, we have evidence in this that if such masses have any constructive function to fulfil, if they are factors in the completion of the Cosmos, it is only as a product for consumption by which the life of the planet worlds may be supplied.

Properly speaking every comet is at the same time a cloudspot, its figure and appearance depending upon its proximity to the planets. Imagine for a moment the surface of some natural reservoirs, -- say a lake, a river and a mountain stream. What should we see if we threw a handful of dry dust on to the surface of each of these?

In the case of the lake the dust will take the shape of a flat round cake, with the centre slightly raised; in the case of the calm river, it will take an oval form, with the broader and thicker end in front as it drifts; in the



Planetary cloud in the constellation Aquarius, N. G. C. 4628.



Starry cloud in the constellation Auriga, N. G. C. 1137.

Cloud in the constellation Andromeda, N. G. C. 116. M. 31 (Herschel).

Cloud in Orion, N. G. C. 1179. M. 42.

third case, that is of the swift rivulet, we shall see the main mass rolling quickly on the current while, behind, a conical tail of more or less scattered particles is quickly formed. A similar process takes place with our comets Falling into the cosmic tide, as dead matter destitute of organs of movement, they float in space in spherical form until they drop into that network of moving gases which we described. If their direction is towards the centre they preserve their oval rounded shape till they reach the sun, but if they touch the edges or the sides of this gaseous basket, they are drawn out in the shape of rockets with a longer or a shorter tail, according to the place of contact.

So in reality it proves. The comet first appears through the telescope in the shape of a round spot, and a marked change becomes observable when it attains the perihelion.

Comets occupy a space in the solar system which, thoug large, is still insignificant in comparison with planetary clouds. I shall dwell upon these planetary clouds, in order to show their connection not with protoplastic but with dissolving worlds.

Planetary cloudspots are those which have the appearance of a star or planet. They emit a feeble bluish light, and some of them can be seen by the naked eye, whilst others can hardly be detected even with the help of large refractors. Their bulk is sometimes very great, and their shape most erratic. For instance the cloudspot in the constellation of Orion, is several thousand times larger than our whole solar system, and in one part resembles the open jaws of a wild beast. The clouds in some constellations have a spiral conformation; in the constellation of the Calf we observe a crablike shape; in Andromeda a disc; in the Dragon a net.

But for us not their form but their substance is important. The fact that on examination of these cloudmasses the telescope revealed in cases the presence of globular starry worlds, caused astronomers to assume

that a cloudspot is in the nature of an unfinished cosmic system. Spectral analysis led to a threefold result. Some masses yielded a level uninterrupted solar light; others gave only lines of nitrogen and hydrogen gases, and finally the third class combined these two. For example I will take the spectral analysis: of 1st, The cloudspot in Andromeda. 2-nd cloudspot in the constellation Auriga and 3-rd cloudspot in Aquarius.

The cloudspots in Aquarius and Andromeda are remarkable for their close resemblance to one another, for their internal rings of an oval form, which in both cases. starting from the centre, bend in similar curves, and intertwine alike. The spectrum of the cloud in Andromeda is unbroken, proving its starry nature, though as yet the most powerful telescopes have not revealed any of its separate orbs; the spectrum of the cloud in Aquarius, on the contrary, consists of three bright lines, indicating an incandescent gaseous mass; and the spectrum of the cloud in Auriga furnishes a double spector — one unbroken, belonging to a star, the other consisting of three bright lines, again indicating a gaseous mass.

I begin with the analysis, of the lastnamed cloud, which indicates, as I said a double spectrum, gaseous and solar. When we look at this cloud through the telescope we shall see that in the middle of it there is a triple star, and it scems evident that it is this star which furnishes the uniform colour dividing it from the lines of gas determining cosmic cloud. And here naturally the question arises whether after all this triple star is really united in any way with the cloud?

I assert that these two are perfectly independent, without any intrinsic connection, since experience and analysis of phenomena on earth show that as soon as incandescent gases approach the neighbourhood of any burning or shining body they at once surround it, and appear to unite in one common fire. The solid or liquid bodies within may gradually explode but their explosions will not change the luminous picture of com-

bustion. In the cloud mass of Auriga there are two separate phenomena — one the result of the living force of the triple star, the other proceeding from the cosmic mass of decomposed and decomposing gases.

I have said before that every cloudspot is a dead or dying body, which has lost the organs of vital motion. All active cosmic bodies — asteroids, moons, planets, suns and stars have a spherical shape, a fact which is illustrated in the case of our own solar system. On the contrary dead cosmic bodies, cloudspots comets and planetary clouds — have an oval shape. It is evident from this that bodies of the latter class are floating with the cosmic tide, and have no rotatory movement round their own axis. The cosmic stream flows in the opposite direction to the foward movement of the planets, and therefore it is not difficult to conclude that the cloud-matter floating with this stream is lifeless, Life is a forward movement, and shews itself such, in all the starry universe, in one eternal progress, All that is falling back and drifting down is dead material without the vital principle, and if such matter has a meaning and a use for living worlds, it is as food and nourishment. In the cloud-mass of Auriga we are therefore presented with a double phenomenon; the vital star, and the extinct material of a system already perished.

The clouds in Andromeda and Aquarius serve as a link in our chain of evidence. They clearly confirm my theory. Both, as we saw, are strikingly similar in their oval rings, whilst their spectral analysis produces opposite results, showing that whilst the former cloud is a still vital system, the latter is an extinct mass of incandescent gas

The photograph of the cloud in Aquarius shews that this was at one time a solar system. In the middle of it we see an oval mass with ring-like sections, and at the sides two similar oval fragments — as it were the remains of orbs. At some period or other, when this system became extinct, the cosmic force of oxo-hydrogen

exploded it; its sun perished, and with it of necessity its planets.

In describing the solar system I think I sufficiently demonstrated the vital tie between the sun and its satellites; the former appearing as the source of heat and light, necessary for the support of vegetation on the planets; the latter acting as the grand laboratory of oxo-hydrogen needed for the solar fire. When this connection ceases and this tie is broken, the system itself perishes. This is the result we can observe in the cloud-mass of Aquarius: — a perished sun, extinct planets, a dissipated system, with only dim outlines of its former shapes.

The photograph of the cloud in Andromeda presents a different picture. Though the form is also oval, cosmic life is still in evidence. By the side of the mass we notice two small stars, very small it is true but nevertheless spheroidal, and solar by their spectrum. In the middle are two peculiar planetary bodies of which one, though oval, points in the direction opposite to that of the general mass, and the other preserves a globular shape, showing that it is as yet only losing and has not yet lost its vitality.

Judging from the spectral analysis one might indeed take the cloud in Andromeda as a system in process of formation, but from phenomena which have been observed this view can be disproved. In 1885 in the thickest portion of the cloud appeared a star of the 6-th magnitude, which was reduced in six months to a star of the 11-th magnitude, and at the present time has become invisible even through a powerful telescope.

If in any cloud there still exist living stars this means that the mass has not yet lost its significance as a solar system in the Universe, and the spectrum of such a mass is entirely unlike that of those cloud-masses which are totally extinct. If, however, the cloud in Andromeda was a system in formation then the stars appearing in it would increase and not, as in fact, diminish; the dimi-

nution and subsequent disappearance of its stars is an incontrovertible proof of dissolution, indicating that in the not distant future our astronomers will read in its spectrum the lines of incandescent oxygen, hydrogen and azote.

Finally the cloud-masses in the constellations of the Maiden and the Hunting Hounds by their very form present the appearance of dissolving bodies.

Having thus glanced at the planetary clouds as extinct solar systems it will not be very difficult to find their connection with the comet world, or, in clearer terms, with the scattered cloudspots floating in cosmic space.

As soon as a solar system becomes extinct, the universal element of oxo-hydrogen comes to its aid, striving with all its might to support the process of dissolution.

We ask naturally at this point how suns perish?

There are two causes for this phenomenon: insufficiency of cosmic nourishment and lack of oxygen to maintain combustion. As oxygen is the product of the planets it may happen that some of these orbs, having developed into double stars, pass out of their former system, since all such double stars lie outside solar systems and have independent orbits of their own.

As soon as a planet leaves its sun the combustion of the latter is lessened, a diminution of energy that reacts injuriously on the remaining planets, which, accustomed to a certain quantity of heat, feel its abatement, and respond by a reduction of vegetable life. A corresponding reduction in the planetary production of oxygen is a necessary consequence, and the sun, no longer nourished in sufficient quantity, gradually dies out till it becomes a lifeless though still incandescent globe. Cosmic gas now appears on the scene and, by its energy, tears into pieces the dying sun, preparing from it in this way that cosmic material for living worlds which we call planetary cloud. The unbroken spectrum disappears and lines take its place; lines of nitrogen, the former constructive solar element; lines of oxygen, the gas which still maintains

combustion on the perished globe (otherwise its form would be invisible to us); and lastly, lines of hydrogen, the destructive agent ever ready to explode anything in earth or heaven which falls within the scope of its action.

A want of comet matter to serve for substantial nourishment to the sun, the second cause of solar extinction, enables the planetary oxygen to burn up the solar orb too rapidly, which also leads to the destruction of its system.

Of the planets round a sun only those can remain alive which have satellites or a moon. The moon, as we saw, electrifies the planet and sustains its forces of vegetation; and therefore, if the planet of a perished sun is able to gain a place in some other system, it is saved. It is in this conscious relation to the Universe that cosmic reason is revealed in the planetary world.

That comets do not pass by the sun, but fall upon it, is shown by the system of sun spots, of which so many appeared on the solar disc in 1894.

Sun-spots.

Although the study of the sun through optical instruments is attended with great difficulties, nevertheless there are some solar phenomena which, thanks in part to skilful mechanical and other devices, in part to cosmic occasional opportunities — eclipses and so forth — have now been more or less fully investigated. Amongst such we must number solar protuberances and sun-spots. The latter are ascribed to various causes, none of which however seem demonstrable on scientific ground, appearing rather sheer inventions than reasonable hypotheses. The definite results of observation have gone no further than establishment of the two facts, firstly, that sun-spots change their form, and secondly, that they change their position.

Imagine a furious fiery furnace the flame of which spreading in more or less level rays of reddish yellou, presents the form of a rounded mass of fire, and suppose that a green branch of a tree is thrown into this fire. Before burning, this bough will emit a liquid which will generate a dark-coloured smoke so dense that it will conceal the flame beneath it, and this dark spot resulting from the cloud of smoke will be seen to change its form as the bough begins to burn, while movements of the flames beneath, owing to wind or other causes, will produce a corresponding change in the position of the cloud caused by the fresh fuel.

Imagine then, instead of this, the enormous fiery disc of the sun, upon which from time to time, fall fragments of comets and of cosmic clouds. Obviously the arrival

of these masses must be attended by disturbance of the solar flame. The fresh cosmic fuel before combustion will produce dense smoke, which will be visible from earth in sun-spots, corresponding in size and appearance to the bulk of the burning matter. The changes noticeable follow the results of combustion, and the movement is accounted for partly by the revolution of the sun upon its axis and partly by the unequal flood of gas, which, rousing the solar flames throws them to a greater or a lesser height. Such, in broad terms, is the cause of sun-spots.

It is remarked that the appearance of spots on the sun is accompanied by atmospherial changes on the earth. The more sun-spots appear, the colder it becomes; the less, the warmer. The year 1894 supplied convincing proof of the intimate connection between the temperature of our globe, and the appearance of these spots. Rarely have so many comets crossed our sky as in that year: As many as three star-comets were remarked, of which two were visible to the naked eye, and in addition to these four large cloud-spots were observed.

I have just presented the picture of the formation of sun-spots, in the figure of a furnace into which a green bough has been thrown. Let us see what must take place.

In the first place, wherever the material was thrown a dark smoke would obscure the flame; in the second the temperature of the furnace would immediately sink-as can easily be shown by actual experiment. This occurs in consequence of the fact that the radiant energy previously heating the surrounding air is now centred on the task of heating the fresh fuel to the point of combustion.

Is it not a parallel process we remark in the case of the sun? All the comets pass across the sun's disc, and in passing leave a mass of cosmic matter, subject to combustion, naturally causing sun-spots, and while these masses are heating, an obstacle is opposed to the diffusion of solar heat, the source of planetary warmth. It

follows naturally that the temperature of earth and the other planets sinks the lower, the more spots appear on the sun. In 1894 an unusual number of such spots dimmed the solar disc, and these explain the unusual cold experienced in that year, — a chilliness which many scientists tried to account for by a gigantic ice-flow which was supposed to have broken away from the arctic icefields and floated down into the Atlantic in the neighbourhood somewhere of the Gulf Stream.

On paying attention to scientific researches as to the movements of comets we remark the following. Whenever any planet passes through the orbit either of Jupiter or Saturn it changes the direction of its parabolic course so widely that this change can be seen through the telescope, its movement towards the sun being appreciably delayed by this divergence. Astronomers assume that both these planets are so powerful, that by the force of gravitation they influence these passing comets. I do not deny the influence, but I ascribe it not to a law of gravitation, but to a general law of perfection reigning amongst cosmic spheres, which develops planets into suns, continually approximating them to that ideal.

In an earlier chapter I affirmed that the goal of every planet is to become a sun. The more perfect a planet, as I explained, the further from its sun is its solar orbit; whilst, for the final formation of a sun, independent combustion, the formation of an independent planetary or satellite system for supply of oxygen, and a supply of dead cosmic matter are indispensable conditions.

When we analyse each planet separately we find that Saturn approaches the most nearly of any in our solar system to the perfect state. It owns 8 moons and a ring of cosmic matter so broad that our earth together with its one satellite, could easily lie within its spread. We need have no hesitation in pronouncing Saturn the most finished of our spheres since we see that it supplies most oxygen to the sun, draws most electricity from its moons and in the formation of its cosmic ring proves

its power of attracting to itself, like our sun, the elements of solar nourishment.

That the sun feeds its fires with comets is an indisputably proved fact, but, judging from the ring round Saturn, and the influence of that planet and of Jupiter on the course of comets, we must conclude that the planets themselves are disposed to share this nourishment, or, if not, it would be difficult to explain the comparative size of the remoter planets compared with the interior planets Mercury and Venus.

If we look up into the sky on a dark night we shall witness the phenomenon of what is called "falling stars", which in reality are œrolites or little fragments of dead worlds floating in space. Certainly they have their own course in immensity, beyond our research; but we know only that their course has carried them into our atmosphere, where we can compretend and describe their destiny. Nitrogen, as a heavy gas, perpetually presses towards the earth's crust; while the cosmic world moves in an element of oxo-hydrogen. When this movement of cosmic matter is taking place outside the atmosphere with the drift of the cosmic tide, there can be no question of friction, but when this movement enters our atmosphere two currents contend, one the current of cosmic oxo-hydrogen, the other that of the heavier gases pressing to the earth. Then ensues friction of the solid matter against the azote, engendering heat, decomposing the double cosmic gas into its constituent parts, and causing the flame of what we know as 'shooting stars'. In September and October shooting stars are to be see inn such quantities that to count them is impossible. It is evident that at this season the earth passes through a special mass of cosmic ruins which our planet absorbs, and thereby increases her own magnitude. The scale I have furnished of the magnitude of the planets indicates clearly that the distance of a planet from the sun is approximately in direct proportion to its age, and that the older a planet is, the larger. From this we may

infer that the source of growth which we can thus trace in the case of our own earth applies also to other planets.

The larger planetary organisms require, in the nature of things, more nourishment, and therefore, when we compare the bulk of Jupiter and Saturn with that of earth, we shall understand the potent influence of the former on the comet world.

We may gather from all this that the solar system as a whole is nourished by clouds and comets and cosmic fragments, borne along through cosmic space. The visible process of absorption is accompanied by sun-spots on the solar disc, shooting stars upon the planets, and, in the case of Saturn, by the formation of a ring. The peculiar state of Saturn suggests the analogy of an egg in which the future chicken is furnished from the white with supplies for the support of its animal existence.

A general review of the solar systems.

The universe is inhabited by myriads of stars. Photographs of the heavens show at times as many as 3000 luminous bodies in one square inch, all orbs living their own life and governed by cosmic law. The chief mark of vitality of stars is their light. Light is the language of stars. Like the fish in the sea they are dumb, but like the phosphorescent animal organisms in that element they indicate their thoughts and desires by luminous phenomena.

Look up into the firmament at night. What a wonderful panorama of lights is spread above us! Here one star is throwing out all the colours of the rainbow; another near seems to blush a uniform red in confusion at its own poverty of colours; a third is sending down a pale blue ray of aristocratic tint; a fourth shines with yellow light; some seem to glance like the eyes of a coquette; others gleam like a lantern; some appear to wink unceasingly; others to fix upon you an eternal stare.

The scientific world divides these starry spheres into two classes, the first including those fixed suns which shine with their own light, and the second such orbs as merely reflect such solar light-viz, the planets and their satellites. But such classification is mistaken. If the world of stars reveals its existence by light, why should we exclude the planets and their moons. There is no doubt but that these have their own phosphorescent or electric light, which lies concealed by the prevailing brilliance of the sun, unnoticed as the light of a candle in broad day.

The stars which we can see from earth are suns. We cannot tell how many exist in nature, possibly an immense number; but only a few such are visible -to the naked eye. Their names are, — Sirius, the star of Bitengeis, Rigel, Aldebrandt, Arcturus, Beta, Bega, Jota, Gamma, Capella and the Little Dog. There is no doubt but that all these have their own solar systems, without which we know they could not exist; but as they are so distant the most perfect telescopes cannot help us to study or even to discover their planets. Their distance from us is inconceivably great. Sirius, which is 150 times larger than our sun, is visible from September to May as a small diamond star. Lying over the 30 degree of southern latitude it is seen from our northern hemisphere at an angle of 35^0 and its light travels to us in 14 years and 2 months. However there exists another scientific supposition that each star is a sun, but from their infinite remoteness some lie beyond research. The foundation of this theory is the exclusive luminosity of suns; but the foundation is unsound. There are stars of the second magnitude which are comparatively near our earth, which do not present solar phenomena, but yet shine with their own light. The star Pegasus for instance, one of the second magnitude, visible to the East up to midsummer and passing then to the South, though remaining in sight right up to February, can be examined even through a small telescope. The outline of seas, mountains and valleys can be distinctly traced, and therefore the life of the globe is clearly not a solar life, though the globe shines with its own light.

Every solar system includes, a sun, planets with their satellites and comet clouds. The sun, warming the planets receives from them in return ozone; the comets nourish both. The question arises — Whence all these rolling spheres, and whither? Are they temporary phenomena or is their existence without end?

The spark of all life is unquestionably divine. The human mind cannot penetrate to the First Cause, nor

comprehend the origin either of nature or of nature's laws. But given those laws, the inquisitive human intellect can grasp their sequence without difficulty, tracing effects to causes and causes from effects. Looking at the planets we saw that those further from their sun boasted the most satellites; those which were nearer, fewer. The significance of such planetary satellites was indicated in the description of our moon. The moons were not supplied to the planets from their birth, but were added with their growth. Added, that is to say they possessed, themselves, an existence independent of the planets before they fell under planetary influence, and only became the servants of these larger globes later on. In the table of our solar system the reader will remark the small planets or asteroids of which, as I, said, 300 have been abready investigated. These asteroids lie at a distance of from three to five hundred million versts from the sun, and there is little doubt but that similar bodies are to be found everywhere throughout the universe. Nothing then could be more natural than that a planet approaching perfection should attract such bodies by its energy and convert them into moons.

The source of these little planets called asteroids is and clearly must be, the sun, which therefore appears in a new light as a star or planet in the ecstasy of childbirth. Though astronomical science docs not recognize that the sun bears planets and my argument is confessedly hypothetical it is hypothesis with scientific ground which I will now produce in justification of my idea.

All geologists are agreed that our earth in its origin presented a molten mass which in the process of hundreds of thousands of years gradually cooled. Not to believe science is to disbelieve nature and life itself; but if our earth was originally a molten mass as science alleges we would ask from whence could such a mass appear?

We know that by a fundamental law of the universe there can be no effect without a cause; we must there-

fore seek for a cause. Astronomy is perpetually revealing the existence of heavenly bodies before unknown, and of course these bodies could only be discovered owing to their being either intrinsically or reflexively luminous. Hundreds of centuries pass and still discoveries continue, from which we may know that world-building still goes on, and the cosmic universe is incomplete. The initial form of the cosmic globe geology tells us is a molten mass, and in the light of these facts I ask the question: Where can such molten masses spring into existence? Can a firm and solid cosmic body spring out of nothing? Can it be the product of moons or planets or comets?

Only the Divine Creator can bring something out of nothing, and the process by which He does this is entirely beyond the limits of human science. But having created the universe and its matter, the Highest constituted laws governing this creation which are immutable and remain superior to all human power. These laws however, can be grasped and understood by the mind of man, and by the legitimate exercise of our intellect we are led to the fact that every new body contains in it only those elements out of which it is made. If we suppose, for arguments sake that there really exists in the universe that cosmic ether which astronomers have imagined, then, as our earth is moving through this element, its traces must be found on the earth's surface, where however, in fact, we can find nothing but atmosphere. It is evident therefore that this ether cannot be an element to produce a molten earth.

Our atmosphere, judging by chemical analysis, supplies potential elements of water and vegetation—but no more: its transformation into a molten mass is impossible.

The earth, it is true, in vulcanic eruptions furnishes molten matter in the form of lava, but this lava never quits the earths' surface, but remaining where it is discharged gradually cools, becomes subjected to the influence of atmospherie changes, and at length becomes

assimilated by the soil so far as to form ground for vegetable life.

The moon, on careful study appears itself to be a product of volcanic agency; but no observations yet conducted would lead us to suppose that any volcanic globes could owe their own origin to volcanic energy. On the contrary, this sphere like the earth is obviously a cold body in repose.

The comets we have just seen are not integral bodies but grouped masses of cosmic fragments, visibly dissipating and not even tending towards corporate reformation.

Thus of all these conceivable sources — cosmic ether, planetary atmospheres, the planets, the moons, the comets,—none could conceivably originate a ball of molten matter such as the planets must have been at birth. Only the sun remains the possible parent of such progeny.

It may be objected that the same scientific world to which I have appealed so confidently, never revealed in any of its researches that the sun actually produces or ever did produce cosmic bodies. I would answer that this is true, and that my conclusions are therefore hypothetical; but my argument rests upon a sound foundation. World-life is an everlasting succession of new-births; and if we see all around us these fresh existences springing into being, why must we assume that this law of production ceased to act, as though paralysed, in the world of spheres. We see that these heavenly bodies are ever moving, and as all the life of nature is a forward progress, a movement in advance, it seems clear that these bodies are alive. We must conclude that every living thing exists for definite productive aims—every where for the reproduction of its species, and as the aim of these cosmic spheres is the reproduction of their species, to be followed by their own death, so it is evident that the death of the perfected heavenly orbs called suns can only be expected to take place when they have discharged their essential function by bringing into being new globes

which, in their turn, passing through all the stages of cos mic growth, will in the end become new suns.

My hypothesis commends itself on the ground that the suns are the only possible sources of fiery masses such as the germs of planets, and that being asthey are themselves huge balls of flame, of dimensions inconceivably vast, they seem the natural parents of bodies on a small scale like themselves. The protuberances standing out on the surface of our sun, as witnessed and examined in the case of solar eclipses, reach a height of 180,000 versts, and these solar elevations are in plain language tongues of flame. If the reader can picture to himself a tongue of flame 15 times the length of the earth's diameter, he will be able to form a conception of a solar protuberance.

Finally all the universe of stars and planets, excepting the sun-stars, are such laboratories that their emission of large fiery orbs would result in their destruction. In the process they would inevitably set themselves on fire.

All the presumptive evidence leads in this way, to one conclusion, *viz.* that the creator of planetary worlds must be a sun; and if we have not yet been fortunate enough to witness the actual birth of any globe, we con account for our failure in this matter by the following considerations. a) Such phenomenon has never been the object of human search. b) There have been no planetary births so far as we can tell, since science has begun to occupy itself with study of the sun. c) Owing to the sun's distance from the earth astronomical instruments could perhaps not detect a globe which at its birth would probably be smaller than our asteroids, which themselves, notwithstanding their comparative nearness to our earth, can hardly be observed even in the most powerful improved modern telescopes.

The origin of suns.

Passing from the theory of the origin of planets I have only to consider now the theory of the origin of suns, after which we shall have before us the entire scheme of cosmic life and action

If our sun were a vegetable growth, a product of our Flora, it would be easy to prove its vitality, because in vegetable growths the sexes are united in a single specimen; but the sun lacks the chief mark of a vegetable growth, it has no root attached to foreign soil. Moreover its spherical shape renders it essentially unfitted for attachment, and it moves freely in the gaseous environment which astronomers name ether, but which I believe to be oxo-hydrogen.

We must take it then that our sun is an animal organism, and as animal species are propagated by copulation of individuals of different sexes, our sun is itself the result of such a union. The planets as they approach perfection, are removed farther and farther from the sun, and there perfection seems to consist of increase in bulk and desiccation. I have said nothing until now of the process of desiccation because in subsequent chapters upon our earth I have devoted an entire section to this subject. The size of planets is increased by assimilation of cosmic matter, and as their planetary service to their sun continues right up to the time when they pass beyond the orbit of solar influence (which influence we must bear in mind is inversely proportional to the square of the distance) these planets as they increase this distance begin to subdue and attract the asteroids which meet

them in their course. Such smaller planets they convert into satellites and moons, and with the solar electricity derived from these satellites they support upon their surface the flora which in turn supplies the solar stream of oxo-hydrogen. In this way they preserve their cosmic function in supplying the fires of the sun with needed gas. But the more perfect a planet becomes the more heat it contains within itself, and the time at last comes, when, developed to the necessary extent, it passes from its sun and begins an independent life in space. The fixed stars of both our hemispheres present such instances of independent life, to which our planets themselves are tending.

New life creates new vital functions, new joys, new conditions; and then, passing through these charms of vitality it reaches death. We see it in our own human life. We are born, we are bred up, we pass through childhood, with its subordination to elders, we attain full age and independence, we marry, we produce our like, and then we die, returning to the elements from which we were formed and leaving the world's stage to a new generation which repeats our own experience. This is the universal course of all natural life, its fundamental principle; all moral dogmas which contradict this, being false to the foundations of cosmic life, are brushed aside by that life in its course, as worthless rubbish. And indeed one must confess that human fantasy is inordinately and incomparably rich in its nonsensical aberrations. But of that I will speak when I come to consider the laws of human morality.

Let us glance now at the cosmic life of the planetary kingdom. The little asteroid, only just freed from its solar shell, flies out into space charged with the element of oxo-hydrogen itself still full of the parental fire; and here in space the cosmic gases begin their work upon it. In order to render it a useful member of the cosmic family it must be cooled down, but cooling it must yet preserve sufficient heat to keep alive its vital

energy. Its vitality is at first weak: it cannot influence the worlds around and it follows the course of cosmic life for some time unoccupied. But the hydrogen gas continues its work, yielding to the new-comer the quantity of oxygen which it requires to sustain combustion, and receiving in return some of its solar heat, to be conveyed to more perfect planet worlds to aid their vegetation. From this planetary flora this active gas borrows more oxygen and flies back with it to the sun, ever returning on its fruitful mission to the planetary globes. In this way maintaining the life of the little planet it cools its surface and forms its crust, which remains for a time in an imperfect and inactive state. But this unwearying agent ploughs the lifeless soil; mountains and valleys form in which it hides: rivers, lakes, seas appear and the asteroid becomes a working planet.

But the little world thus introduced to labor works fitfully at first;—fitfully because its own position in the universe is uncertain and its movement under the greater or lesser influence of cosmic gases, and the action of cosmic heat—the radiant pushing force proceeding from the sun — has as yet no fixed orbit But one fine day, wandering in this way through space, it falls under the attractive power of some big planet and becomes a moon. Accompanying this planet in its course it passes farther from the sun until, at last, the world of which it is the satellite meets with another world of opposite sex. Sexual attraction uniting these planets, wakens their cosmic passion, and bursting into flames they turn to suns. At once their environment is changed. Instead of solar laboratories these glohes have become suns, needing their former gaseous product. But a corresponding change takes place in their satellites: the asteroid which became a moon becomes a planet in its turn, taking an orbit of its own and producing its own vitalizing gas, and finally seeking its own satellites to support its vegetation.

The new sun in its amorous ecstasy creates a new planet world, parting altogether with its old centre, and

that centre wanes. Planet after planet passes from this parent sun, until at last, deprived of too much vital gas its influence upon the comet world becomes less powerful. These losses progressively sap its solar energy until the radiant sun of the old system dies out and perishes. Certainly for such a change millions of years must pass, but what are a few million years in comparison with the inconceivable longevity of the universe?

And so our sun, as such, having perished, we ask what further ensues? Can it be that all is lost? No; the nature of these cosmic organisms is still alive; it will change its form, but will not suffer annihilation. Oxohydrogen will enter on the scence once more. The lifeless remnants of the solar globe, surrendered to the cosmic tide, will float along far from surrounding suns in masses still hot though no longer bright with the radiance of heat. Here it is chilled by the indifference of its environing globes and is assailed by the now destructive forces of cosmic gas, which attack it in cosmic storms and torrents. It can no longer shine; it can no longer blossom with the bright hues of floral life. The hydrogen tears it mercilessly, rending and breaking it in fragments of a size enabling it to serve for purposes of cosmic food, with which the life of younger worlds can be sustained.

From such fragments the amorphous masses known as cloud-spots and comets are formed, and the matter of the same sun which once warmed us with its living rays, diffusing everywhere the joys of life upon the planetary spheres, becomes converted into a product for the consumption if not of its own children at least of the progeny of other organisms like itself.

Do we not see the same thing going on round us on the earth itself? Does not the same fate attend the bodies of our ancestors, which serve with all decayed living matter to nourish the vegetation upon which we support existence. We carefully apportion to these bodies consecrated spots; but life as it flows wipes out our memo-

rials, razes our cemetery walls, and often in the place where golden corn corps cover the earth, the dense stalks are drawing nourishment for us from soil which has been nourished in its turn by the dead bodies of our human forefathers.

The appearance of new suns is a phenomenon that has been remarked by astronomers of all ages and the predecessors of the so-called Star of Bethlehem prognosticated to appear in 1892 were only new suns visible in the constellation of Cassiopeia. Where these celestial monarchs are now we cannot tell but no doubt they are vivifying surrounding space and bringing into existence new worlds, at the same time perfecting their own planets with their satellites.

Many are called but few chosen says Holy Scripture, and this may be applied also to cosmic progress. Not all the asteroids we see upon our horizon are destined to develop into suns. Only the more mighty of the globes in space can claim such cosmic preference. If we analyse our own solar system we find in the sun's suite of satellites 8 planets, 21 moons, and 300 asteroids, making a total of 329 subordinate spheres. This calculation also we must remember includes only those bodies of which we know, and who can tell how many more may roll in space around our sun of which science has never heard. And generally, in cosmic space there are incalculable myriads of independent stars, themselves not suns.

Having thus traced the origin and career of solar orbs, let us turn to the current theories of our natural scientists and see how far these theories can be applied to the facts of cosmic life. Noting the gradual passage of celestial orbs from less perfect to more perfect states, we see at once that the doctrine of natural selection promulgated by Darwin is fully confirmed, whilst the dogma of struggle for existence receives no application at all. Even in the life of the animal kingdom upon earth, this latter dogma is applicable only to particular individual instances, and the struggle for existence is no gene-

ral law. In the life of the animal and vegetable kingdoms we must trace the extinction of weaker organisms not to the fact that these where necessary for the support of stronger organisms, but because the productive forces of the latter for the support of cosmic functions were fare more efficient and in some cases the changed conditions of nature herself excluded the possible continuance of these perishing species. We shall have to consider this more fully when we come to consider the life of our earth as that of an animal organism.

And thank God that this struggle for existence is not a universal law of life, for otherwise we should be compelled to suppose that not good but evil rules the universe, and that not God but the Devil created its infinity. Such a conclusion would make of life itself a calamity. Life is a heavenly gift, a thing of joy our poets say; but if we could believe in this all—prevailing struggle we should have to exalt the dark and bitter accidents of life into its essence. And inasmuch as mankind is always striving to attain felicity as his ideal, we should be forced to suppose that man's life is led against the laws of nature, or that these laws are formed in malice against man.

The error of this Darwinian theory is owing to the fact that the great naturalist and savant, allured and fascinated by his own experiments, looked at cosmic existence from below instead of from above. He derived the cosmic laws from particular instances of death and adapted them to his own particular conclusions, instead of regarding these instances of death as the extreme cases demanded for the perfection of surrounding life. In the best constituted governments on earth we meet with draconic laws against offenders, but we must not assume from that, that in these governments there are found no gentler forms of rule.

The fundamental principle of cosmogany is self perfection — the attainment of the celestial cosmic ideal, which as we mortals can see, goes no further and rises

no higher than the solar form. There may exist some other form or forms of cosmic life and growth beyond the limits of these suns, but if so they lie beyond the reach of human research, and beyond our comprehension, just as the tiny parasites can have no conception of seas and rivers, mountains and lakes. It is possible that the visible universe is a mere sea or lake or even a mere pond of some grand and unknown organism in which we move as infusoria.

The creator is grand and incomprehensible alike in the infinitely great and in the infinitely small creation. Examine a drop ot water through a microscope; what a mass of minute animalcule you will see; all creatures moving, feeding, enjoying life in their own way. These being living creatures must have their indispensable organs of circulation and digestion — but what organs! The very animals in their entircty are quite invisible to the naked eye!

This variety, this magnitude on the one hand and minuteness on the other, testifies that in the nature of the cosmic scheme there is no conception of the absolutely great or absolutely small, but only a conception of relative magnitude.

Cosmic Language.

Up to the present we have been regarding the starry heavens as a world of animal organisms. The chief phenomenal symptom of an animal existence is the presence of organs; the organs of breath, nourishment, movement and those by which expression is given to the wants and feelings. These two last-named organic symptoms constitute, so to speak, the language of an organism, and present different forms of utterance in the case of every different species of animal. The bird sings; the serpent hisses; man speaks; several forms of infusoria simply shine. Of the organs of movement nourishmen and inspiration I have already spoken; I propose now to dwell a little on the language of the stars as the organ of cosmic will.

The language of the stars is their light. As the fish are voiceless so also are the spheres. This, too, is in the nature of things, for what voice could carry across the illimitable expanse of sky. Sound only becomes audible through atmospheric waves, and we know that beyond the limits of our planetary air no such firm liquid medium for the conveyance of sound exists. Beyond these limits exist two tides; one the common cosmic tide swimming against which the planetary world meets and obsorbs all that amorphous matter we have spoken of as cloud-masses, cloud-spots, comets and ærolites, borne along upon it; the other the reactionary flood of oxo-hydrogen and radiant heat, which latter I shall henceforth call cosmic heat. This double flow between the planets and their sun, would catch and carry off upon

its current all cosmic sounds in directions perhaps quite remote from the aim of the cosmic speaker. Instead therefore of audible sounds, the stars converse through a medium of electric light.

With the aid of this luminous language they pass safely on their course through space, and perhaps they express by it their moods; but in any case they distinguish clearly the sex, the age and the mutual sympathies of surrounding worlds.

Concerning the phenomena of cosmic love it would be possible to write much, but as my present aim is not to write an astronomical romance, but to expound the theory of cosmic reason, I must refer readers who are interested in such phenomena to the investigations of those who have studied in detail the luminous organisms living on the earth, taking occasion to recommend the best work I know on this subject — "Luminous Organisms", by M. Elpe. (Professor Popoff).

Our oceans sometimes present the appearance of a milky way of shining infusoria, and these tiny creatures resemble in their movements the shining spheres, inasmuch as it appears that they demonstrate their mutual desires by means of increased or diminished brilliancy, and discover by the same means one another's whereabouts. This varying light is strikingly analogous to the light of stars, which, as we know, gleam with varied intensity and many coloured hues.

Both the sun and the plants have their own peculiar light; the former deriving luminosity from combustion of cosmic matter; the latter shining with reflected light, and also with that derived from the movement of their oxo-hydrogen toward the sun.

The atmosphere of the planets consists of nitrogen and the three other primary gases, of which the hydrogen in conjuction with oxygen is always striving to burst through the envelope of hydrogen to reach the sun. This outward effort produces a struggle between these gases, and a friction which raises the general temperature and

induces combustion of the oxygen. The liberated hydrogen and oxygen fly off to the sun, and of their remaining parts the combusted oxygen, united with azote in the form of carbon, sinks to the earth; while the hydrogen is converted into that fine vapour which, in cumulus and feathery clouds, floats in the air above the earth.

Thus what appears to be a mere mixture of atmospheric gases is in reality a struggle; though not, as we shall see afterwards, a blind ruinous contest. We find in this struggle a perfectly reasonable principle (actio and reactio) of cosmic interaction and mutual help between the spheres. The friction of oxygen and azote supplies the different lights which shine from different stars.

But if the planets, and of course amongst them our earth are shining bodies, how is it that we who live on the earth cannot remark this light?

I will try by an illustration to explain why. Imagine that you have lain down at the bottom of a pond. The weight of your body will have squeezed out the air from under you, and this will rise to the surface in bubbles which to you, as you lie among the weeds under the water, will seem like little dark balls ascending. But if at this time any-one standing on the shore should be watching these bubbles they will appear to such an observer of a luminous silver hue. The air-bubbles are therefore dark beneath and light above. Why so? Because the upper part pressing against the water has produced a slight but yet perceptible combustion of the oxygen contained.

The wave-like ascension of the lighter gases in the air is very noticeable to the naked eye on bright hot summer days.

If we could raise ourselves to a certain distance above our atmosphere we should then see an endless multitude of oxo-hydrogen bubbles illuminated by their friction against the heavier azote. This is the cause of planetary light.

And so we see that all the heavenly bodies shine either from incandescence of their substance, as is the case with asteroids and cosmic clouds; or in consequence of combustion as in the case of suns; or by reflected solar light and combustion of an atmosphere as in the case of planets and œrolites; or by mutual action of two bodies as in the case of double-stars. We must now continue our study of luminous phenomena by some explanation of the double-star.

Double Stars.

In the fore-going chapter I said that our sun is a planet in the pregnant state. If this is a fact then clearly such a state must be the result of amorous relations with some other planet. We are presented with such relations in the double star. The chief condition of such a state is that two stars, in most cases of different colour, approaching one another very nearly, to within not more than 32″, live a united life having a common orbit and revolving, not each round its own axis, but on the contrary round one another. The study of double stars began in the 18-th century. If we pass over the researches of Lambert and Meyer we must consider Herschel, an English astronomer of German extraction, and a musician by profession, as the father of this study. He it was who first issued, in 1792, a catalogue of double stars, containing observations of 269 planetary pairs. This edition was afterwards supplemented by two new catalogues bringing up the total number of double-stars to 850, the greater number of which the author had himself discovered. His observations were conducted with the utmost difficulty, firstly owing to mechanical imperfections of the instruments of that time, secondly from the position occupied by other stars having nothing in common with the double stars to be remarked. The fundamental fact established by astronomy regarding double stars relates to their maximum distance from one another, accepted as being not more than 32″. For exact calculations of this kind a special micrometrical apparatus

is employed, furnished with three delicate threads fastened in a particular way to the objective of the telescopic tube.

Our universe is so immense that those millions of versts which the planets have traversed since the starry heavens have been observed through telescopes present in all a distance comparatively insignificant, and this circumstance presents the chief difficulty which astronomy encounters. Owing to this two stars having nothing in common but happening to be at the time of observation on the same straight line, appear as a double star and only after long watching they are discriminated by their increasing distance from one another. Such bodies are called by astronomers optical double stars to distinguish them from real or physical double stars. Herschel in his investigations was extremely cautious in drawing conclusions, and it was long before he declared himself convinced of the existence of any real tie. His first calculations were made in the constellation of Orion and after this a succession of observations in other constellations led him to the conviction that the law of gravitation operated outside as well as inside our solar system.

We have already discussed the law of gravitation and assigned this operative principle not to a fortuitous cosmic fatality but to the intelligence of the cosmic spheres. This cosmic relation, observable and demonstrable within our system, in Herschel's opinion is universal.

The Russian astronomers Otto Stroové and his son William, the immediate successors of Herschel in this field of research, beginning their investigations at Dorpat in 1813, with inadequate instruments, removed subsequently to the Pulkovo Observatory where, in conjunction, they observed more than 12000 stars from the first to the eighth magnitude. Of this number 3112 were recognised as double. The catalogue was published in 1827.

William Stroové arrives at certain conclusions regarding the colour of double stars, their relative size and movement. His European rival in the study of these stars was

the son of the celebrated William Herschel, and his labours were remarkable from the fact that he carried his researches into the southern hemisphere, and, working at the Cape of Good Hope, observed and studied there 2100 double stars.

The observations of double stars is attended with a mass of difficulties owing to the slow rate of their visible movement. Whole decades are sometimes required to distinguish an optical from a physical pair. If however stars which seem in close proximity to one another appear so only owing to a perspective effect, their rate of visible movement will differ, and in the long run they will obviously part company as separate spheres. Of 6000 pair of double stars observed in 1843, 800 noticeably changed their relative position in the sky. William Stroové divides double stars into 8 groups, according to their mutual distance, as follows:

1-st	group:	with	interval	from	0″	to	1″
2-nd	„	„	„	„	1″	„	2″
3-rd	„	„	„	„	2″	„	4″
4-th	„	„	„	„	4″	„	8″
5-th	„	„	„	„	8″	„	12″
6-th	„	„	„	„	12″	„	16″
7-th	„	„	„	„	16″	„	24″
8-th	„	„	„	„	24″	„	32″

From his researches in the year 1837 he came to the conclusion that, of the 653 double stars of various groups which he had examined, 605 were genuine physical pairs and only 48 optical, giving a general proportion of 13 to 1. The 178 pair included in the first and second groups proved without exception physical double stars; of the 263 pair belonging to the third and fourth groups 3 were optical; out of 106 pair with a distance of from 8″ to 16″ 9 were optical; finally from 106 pair of the two last groups 36 were optical. The parts of the northern hemisphere most crowded with these stars were the constellations of Andromeda, Taurus, Orion and the Great

Bear. The southern hemisphere presented fewer cases. In the full catalogue of double spheres, including those observed by American astronomers, the number reaches about 11,000.

The best time for observation of double stars is considered to be from midnight to early dawn.

One of the most remarkable features of the double star is its colour. In the case of single stars we know only three colours—white, yellow and red, with varying shades, while amongst double stars we meet with every possible variety—pure white, yellow, orange red, pale red, bright red, whitish blue, greenish blue, sky blue, pale green, full green, grey and purple. The most interesting combinations are presented by double orbs of different colour. In 1892 an analysis of these colours was made by the German astronomer Neffkong, when the following combinations were revealed: 10 pair—white with yellow; 7 pair—white with red; 7 pair—white with ash-gray; 3 pair—white with green; 8 pair—white with blue; 2) 13 pair—yellow with red; 13 — yellow with ash-gray; 3 — yellow with green, 62—yellow with blue; 3) 2—red with green, 1—red with blue. 4) 5—green with ash-gray; 14—green with blue; 5) 2—yellow with yellow of different shade; 6) 1—blue with blue of different shade.

Amongst these stars those of a blue or green colour are the most interesting, since these colours are never met with in single stars. Many astronomers even regard these cases as mere optical illusions, but the result of scrupulous study in all the chief observatories of the old and new world compels us to believe that blue stars actually exist. We have indeed examples of a white star with its blue satellite, just as we have of a yellow star with its red satellite. There is one easy method of proving that the colour of double stars is no optical illusion, proceeding from a contrasted effect; it is only necessary with the optical screen to shut out one of the pair from view, when, if the other retains its colour, the phenomenon is evidently not illusory. But the decisive proof in

these questions of doubt, is supplied by the spectroscope. Spectral analysis, from the scientific point of view has great significance as a means of determining the orbits of the stars and their rate of movement. Some pairs were so closely united that the strongest telescopes could not distinguish them, and here the spectroscope stepped in and settled the dispute, not only deciding the existence of a double-star but even defining the time required in its mutual revolutions. And brilliant further possibilities lie ahead in the spectral analysis of the stars, since the dark lines formed amongst the decomposed colours of the spectrum, enable us by their shifting to calculate movements amongst the heavenly bodies so trifting as to lie utterly beyond any other means of detection.

To what cause is owing the curious colour of the double stars is a question which remains undecided to the present day. William Stroové was of opinion that the heavenly bodies have no definite colour, but emitting rays of all colours appear to shine with only the predominating hue; at the same time he affirms that if all the colours are emitted in equal proportions the effect is white.

Many astronomers suppose that various colours in stars are the result of varying degrees of incandescence.

Doppler thinks that the colour of a star depends upon the velocity of its movement and its distance from the earth. The intensity of colour is deepened by proximity. The hue changes from white to green, from green to blue, from blue to violet. The effect of increased distance is to reduce intensity; the colour scale passes from white to yellow, from yellow to orange, from orange to red. This scientist applies the principle of light-waves to the phenomena of star-colours.

The spectral analyses of single stars by Fogel furnished three spectra. Red and orange stars gave a spectrum with numerous dark stripes: Yellow-stars, one like our own sun's; white stars shewed a preponderance of blue. From this Fogel inferred an abundance of metal in the first

case and an abundance of hydrogen in the second. The analysis of double stars furnished an indefinite spectrum differing from all the abovementioned types.

Miss Mory must be considered one of the most successful students of double stars. She it was who discovered the periodical separation of lines, thereby supplying a means to determine the time occupied in the revolution not only of the visible star but of its invisible satellite.

Carefully measuring the parting of the dark lines in the spectrum, astronomers can estimate the movement of the satellite. It was calculated in this way that the rapidity of movement in the case of one satellite in the Great Bear was equal to a hundred miles a second. The greatest recorded division of spectral lines corresponded to a velocity of 122 kilometres per second.

When I expressed my opinion that in double stars we see ordinary planet worlds in amorous ecstasy, I certainly did not intend to refer to this category those socalled double stars really compounded of three or four separate orbs.

Pointcaret says that a homogeneous fluid globe rotating assumes a pear like shape and breaks into two parts in the proportion of 1 to 4. He was led to this conclusion by study of double cloud-masses, composed as he thinks of collected gases. But simple observation of these cloud-spots which have passed into our planetary systems easily disproved this idea, for in all instances these clouds were cosmic but not gaseous.

A characteristic feature double stars is the bulge of their orbit. While the eccentric of our planetary orbits does not exceed 0,04, the average orbit of a double star presents an eccentric of 0,45. It was this circumstance which led Pointcaret to ascribe a pear-shape to revolving fluids, but if we are to believe in the theory which traces the formation of the earth to the revolution of fluid matter, we must find out why the planets are not rolled into the shape of pears, and why they have not broken into double stars! There seems no explanation.

One American scientist explains the phenomenon of double stars by tidal friction. He attributes to them immense significance and says regarding them: — The theory of cosmogony only becomes intelligible on study of the phenomena of double stars. That which we call a solar system — a scheme of worlds in which small planets circle round a sun must be considered an exceptional form in the universal creation, the more normal form being a combination of two or more spheres of approximately similar bulk.

It may very well be that this astronomer is partly right. Double stars do indeed play an important role, but not as a development of tidal friction. They appear rather as independent cosmic couples destined by the Creator to bring forth and multiply the stars.

Although there is no precise scientific definition of the cause of stellar colour, still judging by analogy with living forms on earth in which we see each form has its own colour, it is natural to suppose that stars also, being animal organisms must posses their several colours. What do we see in our own solar system? Astronomy asserts that our planets shine only with reflected light; but in that case as the same sunlight shines on all, the same light would reflect from each. Instead of this each planet has its own colour: — Mars is red, Jupiter orange, Saturn white. This seems proof enough that besides the solar light they possess and exhibit to us their own.

If we suppose that the phenomenon of planetary colours is the product of various distances we must remember that in the case of double stars this factor is entirely wanting, and we must seek another cause.

If as Pointclaret assumes a double star is the result of a disjunction of a fluid globe, the parts, being hypothetically but two parts of one homogeneous whole, would shine with the same colour; as however in fact these parts shine with different colours Pournclaret's theory falls of its own weight, whilst returning to the solar pla-

nets we can argue with reason that each world glows with its own proper colour.

Now let us look more attentively at our solar system. We shall note a suggestive gradation in the size of successive planets. The earth we see is larger than Mars, Jupiter is larger than Saturn and Uranus should certainly be larger than Neptune. If until now scientific observations do not confirm this relation in the last-named cas I am convinced that this is owing either to mistaken calculations of the relative bulk of these planets, or there exists a hitherto undiscovered planet united with Uranus as an arithmetical double unit. It, follows that the stronger and more energetic a planet the swifter its movement. The time must come when the orbit of Uranus will unite with that of Neptune, that of Jupiter with that of Saturn, and that of Earth with that of Mars. Bearing in mind then that the spheres are governed by cosmic reason, it is obvious that the result of this approximation will be not any conflict or collision but ultimately the exhibition of cosmic sympathies in the form of new double stars. The investigation of this process is difficult, but in the colours of the double stars and in the colours of our planets we cannot but remark analogies more or less elucidative, and pointing in the direction I indicate. Finally if we turn to the star Albirea in the constellation of the Swan, we shall notice in this double star a phenomenon which we shall also note in embrio in the solar system. The double star in question consists of two suns, one golden-yellow another sapphire; and, strangest of all, it is surrounded by a ring of cosmic matter like our planet Saturn. This ring illuminated at once by both its suns gleams blue and yellow and green, and in the half darkness of night it shines fantastically.

Take Jupiter and Saturn: Jupiter is the most energetic of the solar planets in our system, and 1300 times larger than the earth; Saturn is the second planet and exceeds Earth only 864 times. Jupiter is therefore the

more powerful of these two; a fact which is further confirmed by its greater influence upon the comet world. Jupiter revolves upon its axis in 9 hrs. 55 min. and Saturn in 10 hrs. 15 min. There is no doubt that the orbits of these planets will blend in one, as they widen their solar circuit, and that Jupiter with Saturn will form just such another double star as Albirea, and without changing their several colours will shine as a double-coloured sun. May we not conclude then from all this that the luminous phenomena of stars is a product of stellar energy sex and development, affected by the degree of distance from our earth? Unquestionably the last-named is a factor having much significance, as we can observe in the case of the sun-star Aldebrandt, approaching and retiring from which we can trace the change from rainbow orange light to pronounced reddish yellow.

To determine the orbits of double stars is a specially difficult operation. It depends as I said upon the position of the star relatively to the perpendicular of vision, directed towards it from the earth's surface. For example if a double star has a movement lateral to the earth then its orbit is described in the form of an ellipse, and in this case to determine the corners of the ellipse, and consequently the orbit itself is very difficult, though in picturesque effect the phenomenon gains greatly, because in all such cases there are periods when one star covers another or when both present a pair of star eyes of different colour. The double stars which lend themselves most easily to astronomical research are those which move perpendicularly to the line of vision directed towards the North Pole, since it is almost always possible to determine their orbits, simply by observation through the telescope, but in this case the size of the orbit is not precisely known, owing to the fact that the material mass of the shining globes constituting the double star cannot, in the majority of cases, be measured in the telescope, being so distant from the earth. And without

knowledge of this magnitude it is not easy to find the magnitude of the orbit itself.

Certainly from the point of view of a purely intelectual curiosity, the determination of the orbits of movement of a double star is interesting in the highest degree. The movement of our own solar planets in fully intelligible to us being founded on the principles of mutual aid and self-perfection; the growth of the planets harmonises with the output of solar heat, and the heat energy of the sun is in direct proportion to the growth and maturity of the planets, both these mutual factors being maintained by the amorphous cosmic material of comets and of clouds, but the relations between the principal star and its satellite in a double star are completely different from those which bind the planets to our sun and hence the double star presents an example of quite another cosmic life, of quite new relations; and this it is which attracts the interest and rouses the rival efforts of so many astronomers.

Who knows but that perhaps the ever improving telescope, with the aid of photography and spectral analysis, may in time yield full and precise results?—at present however such results float in the region of ambitious dreams.

The tendency of every planet is to dry up, and to continue this process of desiccation until it becomes capable of passing to the solar state. In this process it derives assistance chiefly from two sources — on the one hand the Sun, on the other Man. The sun says to the planet, give me your oxygen for my flame, and I will send you my heat for your vegetation—and besides will absorb your water in the form of hydrogen, to prepare you for your future state? The earth says to man—I have formed you, vivified you, endowed you with health and all earthly joys: vivify me in your turn; dry my rivers, marshes, lakes, seas; develop in their place my vegetation and you will see what a blessed thing life on

the earth can be! As the seas dry the planetary orbits widen, until at length the internal heat of the planet equals the heat received by it from the sun. From this moment the planet feels itself an independent unit in cosmic life, and experiences a desire to unite in a cosmic union. When at length such union takes place, the heat of both globes in still further evolved, and the luminous radiance throws out all the colours of the rainbow of which I have spoken already, and these colours by spectral analysis furnish transitions from the planetary right up to the solar spectrum.

When a double star turns into a sun it is hard to say whether the two orbs are united in one, or whether only the larger one is burning; but although astronomy has not investigated this question and I am expressing my own opinion for the first time from a scientific point of view, judging by analogy I think we must come to the conclusion that only the larger star becomes a sun and the smaller remains free, for we observe that all the suns visible from earth, excepting of course our own, appear in the telescope as double stars. It may be that what to the eye of the observer, on account of the enormous distance, is an apparent pair; consists of a real sun and its largest satellite; and if we take into consideration the size of the planet Jupiter it seems likely enough that our sun, viewed from some other system, would also appear to be a double star. The transition of a double star into a sun is the natural transition to the family state, so that drawing an analogy between the life of stars and that of mankind, our sun is a planet in the ecstacy of birth; the mother of the little asteroids which can just be distinguished among the outer planets where they reflect the solar light. No doubt there are asteroids also amongst the interior planets, i. c. between Mercury, Venus and Earth, but for two reasons they cannot be observed: in the first place, if they are in the same half of the circuit with the orbit of passage of our earth they cannot reflect the sun's light and if they occupy some

place in the other half then, on account of the distance, they cannot be discerned by telescopic aid. Nevertheless that they exist in these interior spaces is proved by the presence of our moon which, before it became converted the earth's satellite, could only have been one of these asteroids in the interior planetary world of our solar system.

The Milky Way.

At a distance of five degrees of longitude from our North and South Poles, we see in the sky an immense ring, of somewhat branching form, surrounding our earth and the visible spheres. This formation is composed of myriads of big and little stars, and has a whitish appearance, from which it is called in the language of astronomy 'the Milky Way'. Through all the thousands of years of our earth's historical existence the Milky Way has remained unchanged. The question arises what phenomenon can this be which remains apparently unchanged in form and place for thousands of years, when our earth is travelling all the time through space at the rate of 28 versts a second and other solar systems and fixed stars visibly change their positions from month to month?

The clearest explanation of this phenomenon is afforded if we take for purposes of illustration some terrestrial analogy. Let us suppose that we have rowed out in a boat to the centre of a lake and find ourselves there suddenly surrounded by an enormous flight of birds of passage on the wing. Myriads are filling the air over our heads, and darkening the atmosphere around us, and at the same time all the lake on all sides is sprinkled over with those who have taken to the water on their way. What do we see in this picture? In the birds on the wing we see various points of figured lines while in the flocks which are swimming on the water we see also an irregular branching ring similar to what

meets our eyes in looking at the Milky Way. If it were possible to impart to the boat and to the birds a complete uniformity of direction and movement we should have before us a very lively image of the celestial ring.

In the creation as I said before there are two tides; one the cosmic current, the other the opposing stream, of living worlds. Both these tides are steady and uniform, and though there is no doubt but that the progress of the planets changes in accordance with their growth and energy, the change is too gradual to be remarked with any great success by men on earth. We have to define as fixed stars globes which we know are rushing through space with inexpressible velocity, but as this is a velocity which is shared alike by all the spheres around, it affects the visible scheme of the heavens but little, and this scheme remains during all the era of history practically unchanged.

So it is that our Milky Way having a common course with all the solar systems and separate stars seems to us a thing of mystery, and we strive to solve the riddle of its changeless form in various cunning ways, while in reality the solution is quite simple.

Simple I say; but I must add suggestive, for this simplicity suggests much. If the Milky Way is after all a flattened ring of stars, whilst all the other spheres are points in a picturesque combination, it follows that the movement of our solar system is not as we suppose a movement through limitless cosmic space but movement on a plane, in which case we are in the lake, sea or perhaps ocean of some vaster organism. What can this organism be like, seeing that the huge suns and stars which we can see and measure can be but as grains of sand in comparison with its unthinkable magnitude?

The cosmos is immeasureable and there is in it no infinitely great, no infinitely little: its magnitudes are relative, blending in a united picture of cosmic life and motion. "Bring forth and multiply and replenish the

earth" said the Creator to man, and this decree applied to the life of the universe signifies — multiply and replenish the starry world. Such is the aim in essence of every living creature, be that creature man or midget or rolling sphere. But what the ultimate aim of this universal process may prove is a grand secret locked in the bosom of Nature and known only to the wisdom of Nature's God!

The Cosmic Scheme

and

the exchange of cosmic matter.

From what has been already explained, we can now express the scheme of our solar system in the following order:

1) Small planets or asteroids.
2) Planetary satellites or moons.
3) Large planets or satellites of the sun.
4) Double stars or united pairs of solar satellites.
5) Suns or pregnant planets.
6) Cosmic cloud or extinct solar systems.
7) Comets or disintegrated, dispersed cosmic matter of extinct systems, serving as food for living worlds.

Examining in turn all the transition stages of solar being, we observe everywhere a dual relation between planet and planet. If we call the action of one planet in a pair a c t i o, we notice that a corresponding r e a c t i o is instantaneously supplied by the other. But this r e a c t i o is not opposition in our common sense of that word; it is a suitable application of active influence to the interests of the globe, calling forth a new force of mutual material exchange and co-operation. In every such case we notice that these planetary sympathies express themselves in a demand for material exchanges essential to evolution.

On studying the relations between the Moon and the Earth it is remarked that these relations are totally different from those which exist between the Earth and the

Sun, whilst these latter are totally different from those existing between the Sun and comets, or between the partners in a double star.

And indeed when a little asteroid first breaks from its sun shell what is its requirement in cosmic space? Clearly its first need is to become a member of the cosmic family, for which purpose it must be cooled down and pass through all the phases of cosmic life. In the cooling process it is aided by the oxo-hydrogen drawn from the planets by the sun's heat and light, which, under the name of ether, floats everywhere in space. Coming in contact with the hot body of the little planet, the oxygen element instantaneously undergoes combustion resulting in the formation of a vaporous moisture. Thick clouds cover the incandescent ball until its surface cools. This however is only the first part of the process of refrigeration: after this follows the concentrated formation of moisture in the superficial depressions of the globe, resulting in seas and lakes; in other words another step in the evolutionary exchange of material forms. The only remaining need is now the want of vegetable and animal life, and to supply this need the asteroid becomes the satellite of a more perfect world, or what we call a moon, and it is at this stage that it falls first under the influence of planetary inter-action.

Consider now the tie between the Earth and its satellite the Moon. We saw that without lunar aid the vegetable kingdom would perish in the nights, and our polar regions would be without the vestige of vegetation. Thanks to the moon the vegetable kingdom stretches from the Equator to the poles, for the very reason that its presence is essential to our satellite as an evolutionary factor. The exchange of matter has begun. The earth distilling a mass of hydro-oxygen drives it with inconceivable force into the atmosphere, and in their course, these gases bear away the germs and seeds of vegetable and animal life on earth, carrying them to the Moon and other spheres. This phenomenon of cos-

mic exchange we remark on our own Earth, where, not infrequently, our fields yield forms of unknown vegetation without visible cause, from seeds scattered off other worlds and borne to us Heaven only knows whence.

Where then can these seeds come from? In all probability from other planet worlds. Such germs and seeds falling on newly prepared soil of the young satellite, under the warming influences of sun and earth develop and vivify their new abode. Vegetation in company with its helper the insect, passes through all its stages of development. New teeming life beginning in moist and watery centres spreads itself in animal forms over the mountains and the valleys and breeding and interbreeding presents that picture of natural selection which the Darwinian theory so ably and forcibly expounds.

Thus cosmic exchange of matter between the earth and the moon signifies electric energy for the former and the seeds of vegetable and animal life for the latter.

The next exchange of cosmic matter takes place between the planets and the sun, as we saw in an earlier chapter. It consists in the despatch of cosmic heat and the return of hydro-oxygen.

The fourth exchange proceeds between the planets of a double star. In what it consists it is difficult to say inasmuch as this matter has never yet been made the subject of scientific research, but seeing that the product of this intercourse is the appearance of a new sun, we must conclude that in some way or other one planet is heated by the other to the point of spontaneous combustion.

We see the fifth exchange in the pregnant solar ecstasy, and in the relations between the suns and the little planets. These relations are little known to astronomers, as the asteroids themselves are invisible.

The sixth and seventh processes of exchange are the result of solar decline and the cessation of solar action on the planets. The solar system gradually dying is converted at first into planetary cloud and then, in pro-

cess of refrigeration, scattered through space in cosmic fragments, which, in form of comets and cloud-spots, are borne away along the cosmic tide as food for living worlds. Here ensues a strictly material change. The sun in perishing gives up its frame for consumption by other suns. The substance of an extinct life is furnished to support thousands of other lives.

The flights of shooting stars which fall upon our earth in the autumn months are fragments of such cosmic cloud, flotsam and jetsam of extinct and broken worlds.

If we compare human life with solar, we shall find much in common. The relation of the sun to the asteroid is the relation of a mother to a new-born babe, where maternal solicitude concerns itself with all the little infant's wants, and prepares it for its future life.

The subsequent training and education of the growing child corresponds to the relation between the planet and its satellite, while we find an analogy to our civil and political life in the systematic connection of sun and planets. Sexual and marriage relations are presented in the double star. Our Sun is the mother of her planet family. The extinction of suns which turns them into cloud and afterwards to cosmic food, is like human death which turns the human frame to dust and terrestrial nourishment.

All this points to the fact that all the visible world is formed of kindred elements and that the differences we observe are in the productive energies of this matter, which vary according to the phenomena of cosmic heat. In one case the cosmic matter is only cooling, in another the surface of a sphere is completely cooled, in a third it is being prepared for spontaneous combustion, in a fourth it burns and blazes, in a fifth it presents a cold amorphous mass.

I say all this points to the conclusion that the cosmic life is universal and its conditions of reproductive energy everywhere the same, and that there is no need to fear any catastrophous collisions or other grand cosmis di-

sasters No planet will be broken by any comet in its path; no comet will ever destroy the sun; mankind will never perish from cosmic cold on Earth, or Jupiter or Saturn; though, of course, the inhabitants of different planets must differ in many respects themselves. On Jupiter and Saturn where the day is more than three times shorter people are probably three times more active and evolved, though their stature is far smaller than hat of men on earth.

The history of mankind is a convincing picture of the same progressive order. Aboriginal antédeluvian man was a man of bone; man in the epic age was a muscular creature; now we are entering upon the nervous age. Muscle resigns its place as a subordinate if not wholly unnecessary factor in an era of steam, hydraulics and electricity. With the fuller development of electricity as a motive force the mightiest in nature, man will pass through the age of brain. The further course of life Heaven only can foresee, but one supposes that the time will come when cosmic terrestrial evolution will reach its apogee; a time when humanity will form no longer a needful factor and the renowned apostolic prophecy will be fulfilled — "the present earth shall be renewed with fire" while the mighty monarch man, in reality the worm and slave of all-powerful nature, will cease to be -- resigning his place on earth to higher cosmic powers.

With this I bring to an end my remarks on the general scheme of the solar systems and starry worlds with the expression of my gratitude to all the physicists, chemists, geologists and astronomers, for all the knowledge they have gained by their laborious researches in heaven and earth. Their's has been exceptional labour; the laws they have revealed are changeless and everlasting, and we little gods must involuntarily obey these laws. Without any fatuous philosophical fictions, we shall do well to govern our own human life in accor-

dance with the real principles of the universe in which we live.

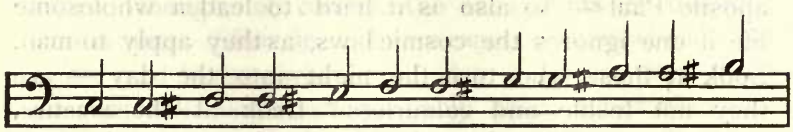
"It is hard to kick against the pricks", says the apostle Paul — so also is it hard to lead a wholesome life if one ignores the cosmic laws, as they apply to man. Look at those who turn the night into the day — are they not feeble and colourless? Look at the ascetics, are they not lifeless? — the drunkards — are they not depraved and frantic? Look at the idler and do-nothing — is not his life a bore to him? It is only necessary to apply the human faculties and at once the divine spark flies; life becomes interesting; human nature wakes to struggle, grapples with itself and evolves new forces. Each *actio* of labour calls forth a *reactio*; not, however, as I explained before, in the sense of mere opposition.

If Heaven blesses labour, it is surely only labour of the sort which perfects and improves humanity. It is incredible that any particular blessing should attend the purely artificial fuss and pother of social conventionality with all its sleepless nights, after dinner carousals, sedentary pursuits and so forth. These forms of action are obedient to the laws of the social, but not to the laws of the real world.

Passing through the consequential scheme of change in cosmic spheres, and comparing it with the scheme of human life, we are struck by the curious signifiance of the number 7. This figure is the symbol supplied by nature in the world of music, and it embraces all the harmonies of the creation: not only so „but the musical scale with its accidentals and pure notes is clearly reflected in every form of cosmic life. Let us examine the scale from this point of view.

Do, is its first note with its sharp accidental leading up to *ré*, which rises in its sharp accidental into *mé*, a pure note. The next note is *fá* a full double tone rising into *sol*, which in its turn rises into *lá*, which in its turn rises into *çi* — a single pure note, and the completion of

the gamut. A simple illustration will shew this at a glance:



Analyse and apply this analogy to the life of worlds and to that of man.

Do—This note corresponds to the asteroid which tends in the process of evolution to become a moon.

Ré corresponds to the satellite moon which tends similarly to become a planet.

Mé represents the planetary stage of cosmic development. The planet must remain a planet or perish, without external aid through the approximation of its like. It is a pure tone in the cosmic scale.

Fá corresponds with the double star, rising into solar perfection.

Sol occupies the position of the sun, which passes by the act of birth into new life.

Lá is represented by the masses of cosmic cloud with their tendency to decompose into constituent parts.

Çi corresponds to the last note in the cosmic scale—the Comet. This is mere dead matter for consumption and has in itself no tendency to evolve another form.

Or take human life.

Do — The infant tending to become the child.

Ré — The youth tending to become the mature adult.

Mé — The man or woman — a final stage (without external aid through union of two) i. c. a pure note.

Fá — A wedded pair tending to become a family.

Sol — The family, in which new life appears.

La — The human corpse tending to decomposition.

Çi — The 'dust and ashes' to which the corpse returns.

If we examine the internal life of man we remark the same coincidence. The common assumption that man has only five senses is incorrect; he has seven.

Do — This is consciousness — conciousness of life and energy expressed in fear, joy, grief, and the tendency to know.

Re — This is sight, a special external faculty, helping man to recognize the objects surrounding him and to strive to investigate them.

Me — Hearing, which by aural reflections supplies the knowledge of something proceeding in the nature around. This would be a pure note if a man remained in one fixed position, for his knowledge of sensations can only be further extended under conditions of locative change.

Fa — Feeling or touch, enabling man to determine the consistency of surrounding forms—whether they are solid or liquid, cold or hot, and of what substance.

Sol — Smell, which is the first development of interior vital activity, furnishing a comprehension of the atmosphere in which man lives; from whence is born the tendency to analyse atmospherical phenomena and substantial objects, and to divide these into classes—the pleasant and the unpleasant.

Lá — Taste, the phenomenon of internal feeling of things absorbed, producing a desire to seek the best and fullest satisfaction; the feeling of hunger.

Çi — Catalepsy, stupefaction and unconsciousness — the cessation of the active senses, in sleep or faintness, again a pure note leading to no further desires.

The same scale we see also in the life of vegetation.

Do — The seed — semitone.

Ré — The sprout and trunk. Semitone.

Mé — The leaf — a pure note.

Fá — The flower — semitone.

Sol — The fruit — semitone.

Lá — The decaying plant — semi-tone.

Çi — The elemental salts after decomposition, serving for nourishment to other plant-life. This, too, a pure note.

Probably some intuition of this natural sequence guided the ancients in reckoning the number 7 as sacred and symbolical, and induced them to take this number in dividing times and seasons. We notice that in the week there are seven days; in religion there are seven sacraments; seven years is the agricultural cycle; twice seven lunar months comprise the year. Finally the seven colours of the rainbow supply the white sunlight for daily life and healthy toil.

Is this all mere coincidence, or is it not rather a key to the unity of celestial and terrestrial laws?

Exchange of matter upon Earth. Terrestrial caloric.

Rain, thunder and lightning, barometrical maximums and minimums.

Of all the planets of our Solar System the Earth which we inhabit is naturally the one most open to research. As we have already seen geologists assert that this earth was at one time a molten mass which only after a lengthy cooling process, which must have occupied millions of years, assumed its present appearance through the formation of its crust.

That the earth in its origin was a molten mass is my own opinion, since I reckon our globe the product of a burning sun, but that this mass was amorphous as scientists suppose I am quite unable to agree, for reasons which I shall now explain. One of these reasons is the vitality of the earth as an entire indivisible organism.

Were the substance of the earth amorphous it would have been unable to withstand the destructive action of oxo-hydrogen gas and, like the cosmic clouds, it would have broken into fragments and dissipated itself through space as comets do, without a special orbit of its own.

Think of a new-born infant; what does it present but a mere mass of warm red flesh? Yet this flesh is alive. It will presently swallow and assimilate the milky substance which it needs to live on. It will grow and strengthen and become fair to look upon; it will develop organs of movement, of hearing, of thought But cut off a part of

an arm or a leg from some strong and healthy man, and through you should drown it in milk and cream these parts will only rot away and turn into food for worms and insects. The difference between the infant earth and the dead comet is the same.

I have asserted from the outset that the celestial world is not a vegetable but an animal kingdom, and that our earth is an animal like other animals, but with a form adapted to its environment of cosmic fluid. It is little to say of it that it swims in space; it also subordinates its movements to the reasonable principles of its own peculiar sort of communal life, aiding the life of other spheres, and in its turn receiving help from them as the means of higher cosmic evolution.

In the universe there is no isolation of spherical organisms; co-operation and exchange are perpetually going on, of which I shall speak as the reasonable phenomena of the planet world. to be inferred from the atmospherical phenomena around us. Amongst these suggestive phenomena I number rain, barometrical depressions, thunder, lightning and the Aurora Borealis.

Rain is the product of the water on our earth. This water, which is the chief source of hydrogen, under the influence of radiant heat is continually distilled in the form of steam, and penetrating and permeating the vegetable kingdom carries off into cosmic space the oxygen produced there. One of the laws of nature decrees that all bodies swell under the influence of heat. The warmer the atmosphere the more dilated the vapour. But the atmosphere as we rise becomes progressively colder, and at a certain height above the earth's surface the watery vapour visibly condenses into atmospheric cloud. Such clouds move over the earth in various directions according to the currents of the wind. Passing still higher the vapour, encountering still colder air condenses into drops and falls to earth as rain. Here, however, I must stop to explain the formation of the barometrical maximum and minimum in the earth's atmosphere.

Our atmosphere in repose presses with a force of 16 lb. to the square inch. If this atmosphere was compounded exclusively of the four gases, hydrogen, oxygen, nitrogen and carbon, in the proportions which scientists generally assume-*viz.* about 76% of nitrogen, 16% of oxygen, 8% of hydrogen and 1% of carbon — these elements remaining in such proportions would not be subject to any necessary disturbance or movement. Though increased temperature in any place would expand the air, and the gases in obedience to natural law, being heated, would rise, the expansion would act also in other directions and the pressure would remain unchanged; and if under such conditions any wind current is conceivable, it must be divided into strata, the upper driving from the Equator to the Poles and the lower from the Poles to the Equator. In reality we observe almost the precise antithesis. In summer southern winds prevail; in winter, northern; while in general nothing is more uncertain than the direction of the winds which gather and disperse the clouds from and towards all quarters of the heavens. What can be the cause of this?

As I said before on the earth's surface there are two heavy gases—nitrogen and carbon, of which the first is the constructive and the latter the nourishing element in vegetation.

Let us imagine a locality in which is growing a normal vegetation, surrounded by all the necessary conditions for its well-being,—a moist soil, adequate supplies of nitrogen and carbon, by day cloudless sunshine, by night clear moon-light. Under the daily action of the sun the vegetable world around distils its oxygen, which, uniting with hydrogen, flies off to the sun. The greater the force of sunshine the stronger the upward flood of gas, and this strenuous element forcing its passage through the atmospherical azote, expands and raises it. At this time the moon, beginning to act by the force of its reflected electricity, comes to the sun's aid, and drawing back the needed nitrogen restores sustenance to vegeta-

tion, and vigour for the following day, leading to an increased output of solar gas, and increasing energy in its passage to the sun. From this progressive process arises that elevation of azote above the earth's surface which is known as maximum pressure; and such point being reached the sun, having attained this maximum, begins to act in the contrary direction and to produce a minimum.

Water is the blood of the vegetable kingdom. In union with azote and silica it renews vegetable organisms, while in union with carbon it imparts vitality and fruitfulness. When any place is parched by the sun's heat, vegetation is forced to exhaust itself in distillation of solar supplies, and at the same time the moisture in the soil is dried up, whereby the supply of hydrogen becomes reduced. The distillation of oxygen continues, but the lack of winged hydrogen results in diminished energy: the balance of power is restored to the downward pressure of the azote, and we remark at last the phenomenon which is customarily called in physical science the barometrical minimum.

Le tus consider the relation between these two extremes and also their influence on the surrounding air. In a given place the maximum of pressure has been attained. The heavy nitrogen is striving to descend but is met and baffled in its efforts by the rising hydrogen which carries up with it ever new reserves of azote. In the upper strata of the air a new current is formed by the opposing forces, a current which naturally runs in the direction towards the barometrical minimum, for between these points the surface of the earth's atmosphere slopes downward. In this way the azote thrown up by the force of hydrogen to the maximum level in certain places, descends towards the minimum upon a sloping plane, and from this proceed those winds which as I said defy the common law of air-currents which would exist and operate if the integrant elements of air remained unchanged.

In conesquence of the energetic distillation of the ighter gases by vegetation, as we now see, a tide or current of heavier gas has been set up. The azote however does not move alone, it carries with it all the gaseous matter that it meets; having reached its maximum altitude and begun to slide towards the minimum, it seizes and bears away the vaporous clouds thickening and condensing them in one large mass and chilling them by its current.

At the point of minimum pressure the azote, descen ding, is warmed on the earth's surface; a lack of wate- is reflected in a lack of hydrogen; the oxygen distiller by vegetation being unable to rise towards the sun remains in surplus quantities in the vegetable world, gradually burning up its own source; and at the same time the air grows what we commonly call close and stifling. This is the reason why plants perish in hot dry places from the sun's rays.

The azote when, with its driven clouds, it has reached the heated minimum of pressure, glides over the local gas. But the moment the chilled vapours touch this heated nitrogen, at the point of contact the element of oxygen present is instantaneously combusted, and from the hydrogen is formed what is technically called dry vapour, a substance which has all the qualities of fulminating gas. This dry vapour bursts upwards tearing and rending the atmospheric clouds.

The explosion of dry vapour clearing the space formerly occupied that space is occupied by fresh clouds which, proceeding as the former, produce the same results, and as at each explosion a mass of oxygen is combusted the hydrogen released, cooling in the atmosphere falls in rain drops on the earth.

Here is the picture of our thunder and lightning which the reader can observe and verify in any place, but he will be able to trace the picturesque inter-movement of storm-clouds best of all at points on the Swiss Alps.

And what I have said of thunder clouds applies also to hail clouds. In the upper strata, clouds are not always of vaporous formation; their vapour in the chilly upper regions having changed to snow, when they roll down upon the heated minimum they are discharged in icy globules of varying size according to the bulk of the snowflakes from which they form. The nature of the hailstone with its coating of ice and snowy centre points to its history in the clouds. The hail which we see in early spring and autumn unattended by storms is formed obviously in the same way by the passage of snow through warmer air.

Hail and thunder-clouds are easily distinguishable from ordinary rain-clouds. The latter are a dark smoke-gray whilst the hail-cloud has a whitish appearance with borders of lurid hue.

The so-called claps of thunder always move in one direction and are remarkable for their graduated course, the graduation corresponding to the passage of the vapour cloud over the heated area of barometrical minimum.

If I were asked why thunder and lightning occur not on the atmospheric surface of the minimum but at some distance beneath, I should argue that the descending hydrogen mass presents a certain weight which must have above it a stratum of air more solid than that which is moving, and secondly, that not every stratum of warm air can convert vapour cloud into dry vapour: for this purpose the heat must be great, and such heat is found only in lower strata.

The heat of the atmosphere before a storm in summer is clearly visible to the eye. The observer has only to turn his glance in the direction of the approaching stormcloud and he will plainly see the surface of the air tinted with the colour of steel heated to a straw-coloured yellow.

What awful force is exhibited in explosions of dry vapour is well-known by bitter experience. A single

vedro of water thrown into a red-hot boiler in a steam-ship or steam factory is sufficient to blow either structure to pieces. For this reason the utmost care is exercised in the use of steam-boilers to prevent the complete evaporation of moisture, as the accidents resulting from neglect of caution in this matter are disastrous and dangerous in the highest degree, resulting often in serious loss of life and property.

Now let us observe what takes place on the surface of the earth itself after the passage of a thunder cloud. We saw that the earth suffers at such times from an absence of moisture, while the oxygen continuing to appear in fresh quantities begins to burn up vegetation. The drops of water falling in rain upon the earth yield their much needed moisture to the ground, and the roots of plants labour to raise this moisture and circulate it through the stems and foliage. The oxygen eagerly unites with the desired element of hydrogen in a new form of combination O_3, called in the language of chemistry *ozone*. Instead of the simple combination of hydrogen with oxygen, we see here a combination of hydrogen with oxyde of oxygen, a phenomenon only observable after thunder-storms. At such times the air is fresh and light.

Whoever follows the barometrical charts in the newspapers will certainly remark that the raised and depressed points on the surface of the earth's atmosphere are very numerous, and that the warmer a country the more frequent these points. Though we have no published particulars of maximums and minimums under the tropics and near the equator, there is no doubt, judging from analogy but that they are more frequent there than in our northern parts. Here a chain of consequences ensues. The more frequent these barometrical points the more pronounced the atmospherical incline; the more pronounced the atmospherical incline the swifter the descent thereby; the swifter the movement of the azote the stronger the atmospherical winds. Sometimes two cur-

rents of azote start simultaneously from two barometrical maximums towards one and the same minimum. These two atmospherical forces coming into collision produce a frightful aërial storm called in the language of physical geography a hurricane, or if the area embraced is small a whirl-wind or water spout. The ruinous effect of these phenomena is known to every schoolboy, and every year brings us fresh records of their disastrous power.

An interesting picture of daily thunder and lightning is presented by the pacific zone which stretches on both sides of the Equator to a breadth of 200 or 300 versts, and shifts with the sun's ecliptic. Every day with the rising of the sun the barometer stands at a fair height and the day starts with fine sunshiny weather, but about eleven o'clock in the morning clouds begin to appear on the horizon and gather up towards the zenith, a barometrical minimum is formed, and from midday a thunderstorm commences. Towards evening the weather clears up, the barometer again rises, the sun comes out and sets in a cloudless sky. It is remarkable that these rains and storms occur only over ocean spaces or such surfaces of dry land as are covered with abundant vegetation. The term tropical forest is applicable to precisely those wooded regions which lie within the tropic zone of daily storms: in the steppes and deserts however, which also lie within the tropic zone, daily storms are unknown.

In all this we see clearly the close tie connecting the solar rays with the vegetation upon earth. Existing under the direct influence of the scorching equatorial sunshine the luxuriant tropical *flora* distils exceptional supplies of hydro-oxygen, and the upward passage of these gases is so vigorous that the wind ceases to be noticeable; the atmosphere rises rapidly, and afterwards, according to the exhaustion of vegetation, sinks to a minimum. The azote thrown to such a height together with its vaporous clouds rolls down on both sides of the Equator in the direction of the newly formed minimums, on the heated

surfaces of which the clouds explode, the oxygen falling to the earth in lightning sparks, and the vapour of the clouds falling in showers on the earth, moistening and refreshing vegetation and supplying it with the means for renewing its vital functions.

The spark of combusted oxygen called lightning is a phenomenal product of the animal warmth of our earth and is called electricity. Sometimes this spark is dispelled in the atmosphere, at other times moving with the current of the air towards the earth it reaches the earth's surface where it produces those destructive effects known as strokes of lightning. The force of lightning is so great that coming in contact with solid bodies it either melts them on the spot or powerfully expands the parts it touches, splitting up trees and rending asunder stone walls.

There exists in Russia a superstition that when thunder and lightning occur Ilya (Elijah) the prophet is running after the devil and driving him into the Bottomless Pit. The peasants confirm this tradition by pointing to the discovery of the devil's fingers found and religiously preserved by the country-folk in many villages. The peasants watch the flashes of the lightning, and when they remark the electric stroke enter the earth at any place they dig the ground up and sometimes light upon some fragment of silica fused by the current. This fragment is recognized as the devil's finger, and traditionally considered in the light of a valuable medicine for the cure of various diseases. Water is poured over it from above and afterwards given to the patient.

In the year 1870, a lightning flash struck the telegraph poles between the village of Mikhmanna and the town Kargopolie, and ran along the wires for nearly two versts. From the stroke the first two poles were torn to splinters and the others were all deeply split, though with diminishing force, the last one being marked with a crack about the width of a double-bass string right down to the ground.

Most often lightning strikes trees growing upon heights, but never such as are situated on the banks of rivers or lakes or in marshy places. It is certain that half the peasants who have perished from lightning have been struck while seeking refuge under trees in dry and elevated spots.

Trees with fresh sap are never split up by lightning but it often happens that people seeking shelter under their boughs are killed; dead wood only is subject to destruction, though living trees on elevated ground do actually attract the electric current, a circumstance which is accounted for by the fact that a desiccation of the soil always precedes the natural formation of a barometrical minimum. Although the tree in such dry places continues to distil oxygen the ground does not yield enough moisture for the hydrogen element needed to carry this away. Hence the vegetation which produced this oxygen retains it, though as explained to its own detriment. The affinity of this gas with the electric spark draws them together, as you will find two vessels burning in proximity on the water eagerly unite.

Not knowing these natural laws our country people seek refuge from storms under the trees, while the ravens and the rooks, from their careful avoidance of such risks, appear by comparison winged scientists. These birds specially love to build their nests in poplars and birches, but if necessity compels them to select a tree in a dry soil, before beginning to build they peck off the bark upon the boughs on which the nests will rest and dry the twigs; but they will never undertake this labor when the subsoil is damp. A glance at the physical laws of formation of oxo-hydrogen splendidly justifies and explains this caution of the birds, for a tree growing in damp ground never dries, i. c. never accumulates an excess of oxygen, whilst the opposite must be predicated of trees growing in arid earth.

A tangible evidence of its electric quality is shown by the influence of lightning on the magnetic needle.

The magnetic current of the earth's surface is over-powered and the needle turns and twists as though agitated by an electric storm, a phenomenon which can often be remarked on the magnets of telegraph stations, because the wires which convey the galvanic currents pass over a large area and becoming charged in the atmosphere of storms, produce a magnetic tumult and confusion.

In my discussion of the general question concerning exchange of matter on the earth I have made this digression and spoken of storm-clouds and the barometrical maximum and minimum, to show that electricity, appearing in the form of lightning, is neither more nor less than the animal heat of our planet, the Earth, the scientific proof of which lies in the magnetic needle, which under such storm influences is diverted from its natural direction. The normal direction of the needle indicates the magnetic force of the earth's life, a force hitherto little known, but which in practical and technical affairs has been of signal service to man. The existence of such vital force can only be doubted longer by an absolute i g n o r a m u s.

Speaking of atmospherical maximums and minimums, I must refer again to the causes of their appearance. Properly speaking the barometrical maximum is caused by increased local supply of oxo-hydrogen throwing up the azote to extreme altitudes. There seems to be no other discovered cause for this phenomenon, but for the barometrical minimum there exist two known causes: the first that which I have described, i. e. heat, producing thunder and lightning; the second an atmospheric chill, mostly autumnal, producing continuous rains.

The cold minimum also is the result of movement of azote. Drifting in the form of wind in the direction of some barometrical elevation this gas not seldom receives a course from North to South. The warm azote further south is then replaced by it, and as cold contracts all bodies, vegetation closing its pores under the chilly in-

fluence reduces its out-put of oxo-hydrogen; the colder azote predominates and succeeds by its increased effective pressure in producing a barometrical minimum, forming an atmospheric superficial slope between this minimum and its neighbouring maximum down which rolls more hydrogen with clouds. As matter coming from heat to cold, the aqueous vapour of the clouds, condensing turns to rain and falls to earth, only not this time as the swift product of storm cloud, but as a prolonged chilly season of wet which only gives place to fine weather on the formation of other barometrical minimums bringing across the affected area other and warmer currents.

Aurora Borealis.

The Northern Lights constitute one of the clearest proofs of the exchange of matter between the Sun and the Earth. This phenomenon never presents itself in presence of a barometrical minimum but always at times of atmospherical maximum. The radiant crown which sometimes shows itself never gives out rising sparks, but is always formed of stout lines of light which rise and fall like the water in the tubes attached to steam-boilers for measurement of pressure. In time of the Aurora Borealis a dark segment appears in the North, rising much higher above the horizon on the East than on the western side.

In our text-books of Cosmography these Northern Lights are considered as an inexplicable natural phenomenon, but keeping in mind the fact that, like thunder and lightning, they produce magnetic disturbance, the idea naturally suggests itself that between these phenomena there is something in common. We must remember also that the so-called Northern light is also seen in the southern sky, having been remarked there amongst others by the celebrated scientist Humboldt. The majority of physical geographies ascribe both storms and the Aurora Borealis to local excess of accumulated atmospherical electricity, which is supposed to produce in tropical and moderate climes the former, and in polar regions the latter effect. But this tells us very little from a scientific point of view.

If we closely examine the symptoms and results of this luminous appearance, we shall come to the conclu-

sion that it is a product resulting from atmospherical agitations of oxo-hydrogen. We will analyse first those symptoms which accompany this phenomenon.

And first we remark that the Aurora appears on the horizon only after the sun has crossed the line of the autumnal equinox, and continues till early spring before the sun crosses the equinoctial line. 2) Its direction is always from S. E. to N. W. 3) Lying in a level mass on the far North, on the South it moves in waves which always roll towards the North, and never in the opposite direction. 4) During its appearance there is an audible noise clearly distinguishable in quiet weather in regions near the poles. 5) It invariably produces disturbance of the magnetic needle, and consequently is clearly a product of electric energy Finally, after its disappearance the sky is always clouded. What can we gather from an analysis of these facts?

The Northern Lights always begin after the autumnal equinox, that is at the time when the equatorial ecliptic passes to the southern hemisphere, a time, therefore, when the North Pole is evidently moving farther from the sun. Meanwhile the oxo-hydrogen, distilled and breaking out sun ward from under the pressure of azote, must fly in the nature of the cosmic arrangements towards the sun, but encountering the general cosmic tide it is turned again towards the earth. This tide of gas outside the planetary atmosphere does not, I assume, flow always in one straight line; if then the direction of the current should be diverted towards the earth; the oxygen would be still more effectually pressed upon the atmosphere at its maximum elevation. The phenomenon is two-fold; fist the initial impetus of oxygen towards the sun i. e. from S. E. to N. W. and secondly the friction of this oxygen against our upper air which, presenting a spherical surface like the globe which it surrounds, imparts a corresponding bend to the stream of gas. This stream runs like a bent bow ower our atmosphere to which it forms a kind of roof, and supplies

the key to the appearance of that darkness in the sky to the far North which I have mentioned as an invariable accompaniment of the Northern Lights. The shining, beginning sometimes from the 65-th degree of latitude, can of course develop waves only towards the North.

2) We saw that the Aurora Borealis produces a disturbing effect upon the magnetic needle. The oxygen as I said coming in contact with the atmosphere produces friction, which in its turn produces light through combustion of part of the oxygen. But combustion of oxygen is always accompanied by electrical agitations, and therefore the movement of the magnetic needle is a natural consequence of the Northern Lights.

3) That this phenomenon is accompanied under certain conditions by audible sound is a circumstance which every gust of wind adequately explains. The lightest zephyr buzzes in our ear; but here we have to do with colossal movements of oxygen over our atmosphere lowering that atmosphere by its mass so far that the sound waves of its friction reach the surface of the earth.

4) After the appearance of the Northern Lights the horizon is always covered with feathery clouds. The cause of this is the release of that quantity of hydrogen which was combined with the combusted oxygen: this hydrogen as we have seen floats in space in feathery forms.

Thus all the details of this phenomenon are readily and simply explicable after all by the plain laws of physics. It is altogether unnecessary to seek some mystery — some unknown, volcanic polar force. Travellers who set out in search of such, are risking their life in a wild goose chase as the Southern Lights show, seeing that in this case the direction of the light waves is the same, whereas were their origin volcanic their direction would be opposite. The common course of both Southern and Northern Lights is owing to the fact that the earth's orbit lies in front of the orbit of solar movement and not on the same plane : both poles therefore conduct

exchange of matter with the sun in one and the same direction.

The action of the Northern Lights upon the needle is strikingly similar to that of thunder and lightning. Two such different phenomena producing result so much alike must obviously have something in common. When we examine them we detect this common factor in the combustion of oxygen which takes place in both cases.

In the case of thunderstorm the oxygen falling on the heated surface of azote combusts in fulminating sparks, and the hydrogen flies out into space with prodigious force and subsequently falls to earth in form of rain. In the other case the oxygen in combustion furnishes merely a luminous display, and the hydrogen instead of falling, floats. The phenomena are identical in essence and vary only in their form.

That thunder and lightning take place owing to combustion of oxygen is brought home to us when we notice that volcanoes no sooner begin to act than their eruption is at once attended by peals of thunder and flashes of lightning. The reason is simple. The fiery lava combusts a mass of oxygen, and the vegetation around is unable to supply the local vacuum. A barometrical minimum or lowering of azote ensues and the atmosphere becomes unduly heated, especially in the upper strata. The barometrical maximums around the volcanic mountain roll down their surplus of azote upon this minimum, and the vapour clouds borne along thither explode in storm on contact with its burning air,

In the barometrical movements of azote charged with watery vapours it is impossible not to recognize that *actio* and *reactio* of which I spoke before as the reason of nature.

Volcanoes.

Geological researches have proved that the cause of volcanic eruptions is the leakage of water through the earth's crust, a leakage which, bringing this element into contact with the incandescent bowels of the globe, causes an accumulation of vaporous forces striving to escape. These being firmly resisted by the pressure of the sea from above, force out streams of liquid lava in those places of the crust which yield the most easily. Such localities are porous and almost always mountainous, with an earthy or sandy or lime-stone soil. Raised already by nature they present less resistance to the movement of these interior streams, and serve naturally as funnels for eruption of seismic discharges.

If volcanoes met no opposition they would spread their fiery streams over the whole earth and burn up terrestrial vegetation, root and branch, and in this way would put a stop to the natural and necessary exchange of matter between the earth and the sun. To prevent such cosmic disaster the principal of *reactio* appears on the scene, in the particular shape of perpetual barometrical minimums over volcanic places, which induce prolific and abundant rains, cooling the fiery surface, stopping the fatal floods of lava and converting with salutary moisture the dry ashes of the fires into nourishing manure, which gives a strength greater than before to the surrounding growths.

Is this not, we ask, an exhibition of terrestrial reason?

The tides as terrestrial respiration; their connection with the earth's animal heat.

Scientists of an earlier age ascribed, as we know, the phenomenon of flood and ebb tides to the attractive force of the moon. This was of course a mere hypothesis, but inasmuch as there was no other forth-coming explanation of the aforesaid phenomenon it was accepted as an axiom, and taught in schools as incontrovertible scientific fact. Later on, however, attention was directed to the circumstance that the moon encircles the earth only once in the day, and that consequently the perpendicular of its attractive force can act only once daily on any spot on the earth's surface; but the tides occur accurately every six hours, that is twice daily. One naturally enquires — if the moon is the cause of the first tide, what then is the cause of the second?

It is evident at a glance that this original theory of lunar influence rests upon very slender foundations, and it is not surprising that it was superseded by another theory, which took its place in the text-books of physical geography. This second hypothesis remains in force as axiomatic truth to the present day. To the attraction of the Moon was added that of the Sun; thus accounting for the daily recurrence of the tides.

I shall try to shew that this hypothetical attractive force of Sun and Moon as an explanation of sea-tides is simply a phantasy of pedagogues and scientists; and for that purpose I shall first turn attention to the nature of the supposed attractive force itself.

Sea-tides, according to locality, attain a height of six, eight and even nine sazhen. Imagine, now, a column of water of only one square sazhen, but eight sazhen high. To raise this mass a force of not less than 8000 poods is requisite. Scientists we must remember do not differentiate this attractive force as acting exclusively upon one certain form or certain forms of matter, but assume that it is universally operative upon all, and operates visibly upon the sea only because that liquid body yields more pliantly to its influence. But two or three simple experiments are sufficient to convince us that an attractive force which is able to raise water to the height of 8 sazhen would not leave a single tree or a single building standing on the firm ground.

If it should be argued that solid bodies are not subject to this attraction on account of their atomic cohesion, I can point to friable substances. The deserts of Egypt and Mongolia supply such masses of loose dry sand that they could cover thousands of versts. I admit that sand is heavier than water, but as water is agitated by the wind, so also is sand — a circumstance indicating an analogy. It seems undoubtedly certain that if Sun and Moon attract the water of the sea they must attract also the sand of the desert; if they can raise the former 8 sazhen, why not the latter four, or even one, or even an arshin, or even an inch? But they exercise no influence at all of such a kind, and therefore we find ourselves compelled to consider this solar and lunar influence as mere scholastic 'moonshine'.

The greatest energy of an attractive force operates perpendicularly: thus the height of the sea-tide should correspond to the perpendicular of sun and Moon in relation to the earth. Meanwhile astronomy proves and indeed any-one can see for himself with his own eyes that the positions of both Sun and Moon and their relative distances often alter, and sometimes both orbs occupy the same zenith. These changes do not in the least affect the tides, which take place regularly twice a day whate-

ver the perpendicular of Moon or Sun may be. From this point of view also the hypothesis of attraction is untenable.

It seems then that we must not strive any longer to find the key to this phenomenon beyond the clouds, but must search for it upon the earth we live on. Is it not at least a natural presumption, seeing that all the products of our earth have living breath, that the earth itself, the great parent and source of life, should breathe? The analogy presented by all the various vital forms around should suggest the inference that the earth itself is a vital form, an organism like ourselves only more perfect. And if so, and we admit that this organism like other organisms must breathe, we have to hand a fully sufficient explanation of the ocean tides.

And so our earth breathes twice a day, from which those with a taste for calculation can easily determine the breathing capacity of earth in connection with the living beings which inhabit it.

Every respiring body must have its system of circulation and animal heat. Terrestrial circulation is a matter for future scientific research, but the fact of its existence can be inferred from the indisputable phenomena of terrestrial animal heat, the first of which phenomena we may consider the magnetic current indicated by the fixed pointing of the needle to North and South.

Any dynamo will furnish a clue to the force of this magnetic current: there exist already dynamic machines which can instantaneously melt even platinum. The application of such power we see, in practice, in cases of electric lighting. One must confess that electric light received through incandescence of either charcoal or platinum wire is not the light of fire; but since the visible force lies in the nature of the magnet it is clear that such magnetic heat is the earth's animal caloric.

A second proof of the earth's animal heat is furnished by the isothermical lines on our geographical atlases. These lines which in the southern hemisphere run gene-

rally in parallel directions, present in the northern hemisphere most extraordinary zigzags. They rise very high to the north side of the Atlantic, not so high to the north of the Pacific, and drop sharply towards the equatorial parts of that ocean and the continent of Asia.

Thermometrical physiological observations of animal organisms show that the temperature of a body is unequal, rising in the region of the heart and lungs. When we examine the organism of our earth from this point of view, taking the position of North and South America as the spinal region, we find that the general law of animal organisms in this respect strictly applies to the earth, as such. Indeed on any other hypothesis the lowering of isothermetrical lines towards the central parts of continental Europe and Asia would seem altogether anomalous, in face of the natural law that solid bodies are more susceptable to heat than fluid, according to which the dry land should have a higher temperature than the surrounding seas.

It will be said that such a source of warmth as the Gulf Stream, flowing as it does past the Western borders of Europe camot be without influence on the temperature of the northern Atlantic, a fact naturally reflecting on the climate of the continent. I answer that in the north of the Pacific, where instead of a warm stream we find two cold streams, which should materially lower the temperature, we see that the isothermic lines rise and if they do not rise as high as on the Atlantic ocean, they are higher than on any other spot of dry land.

I do not deny that the Gulf Stream has and must have influence on European temperatures, but recollecting that by the laws of physics the action of heat is in inverse proportion to the square of the distance, one must assume for the exercise of this influence unusually favourable conditions. We must give Europe perpetual westerly winds, though the prevailing winds upon the Atlantic ocean are easterly. Indeed this tendency of the

ocean winds effectually minimizes the action of the warm Gulf Stream on the continental atmosphere.

In any case it would be ridiculous to suppose that the Gulf Stream could exercise an influence across Europe, not only to the central regions of Asia, but right up to its eastern coasts. This influence can only act upon the shores; and along the western shores of Europe, together with the isothermical lines, must appear perpendiculars indicating the degree of warmth thrown out by the Stream. Further on, where its influence ceases, the isothermic lines should run parallel to the Equator, as in the southern hemisphere. As this is not the case in fact, we are supplied with another piece of evidence in favor of the hypothesis that our earth, as a living organism, posses its own animal heat.

A third proof is furnished by earthquakes and volcanic eruptions. In this connection there is no need for me to describe these phenomena in detail. Information concerning them can be found in physical geographies and in fuller form in the works of Humboldt, Reclus and other scientists: for us, here, the important point is the iudisputable fact of their existence, coupled with the remarkable circumstance that such volcanic and seismic energies are developed systematically in the form of a broken line across the earth's surface, like a gigantic W, the extreme points meeting round the globe.

Taking as the starting point the island of Iceland the end of the first line reaches the North of Australia, passing through Europe and Asia. The line then rises and runs along the western coasts of the Pacific to the N. E. of North America. After this it drops along the range of the Cordilleras to the southern extremities of South America, and thence along the western coasts of the Atlantic, rising once more to its initial point on Iceland. The magnetic currents observe almost identically the same course.

If we take a geographical atlas, and with the aid of a ruler sharpen the corners of the curved isothermical

lines rising and falling in the northern hemisphere, we shall find these straightened lines following the same direction as those indicating the general course of earthquakes and volcanoes. Therefore as the phenomenon of magnetism is the product of organic terrestrial heat it is not difficult to gather from this that both volcanic energy and isothermic measurements, following as they do the same lines, are fruits of the same cause and not results of warm ocean currents.

I shall now try to explain the reason of the marked shape taken by the lines of volcanic action, and for this purpose I must make a slight excursion into the region of cosmic movement in general.

That principal of *actio* and *reactio* which manifestly exists and operates as I said all around us in nature, appears and acts also in this region. The comet world as an amorphous mass, has no organs of movement, and yet we observe that this world moves: how then does it move? It moves towards the sun, that is to say, in a direction precisely opposite to that in which the solar system is moving; and as is this is not a vital movement but mere surrender to an exterior tide, we assume this tide to be the cosmic stream. Until they fall under the influence of planetary oxo-hydrogen comets move very slowly in comparison with other celestial bodies, and this signifies that the cosmic tide is of slower motion than the living course of the planets. The sun with all its satellites rises through this quiet tide, and all the planets in this course meet the reaction to their cosmic heat of this cosmic stream. As we saw our earth moves forward into space with its South Pole in front, and hence we see at once why our wide sea currents all flow from the South Pole towards the North. And if we look at the continents we notice that their sharpened peninsulas and promontaries are pointed to the South and their flattened bases to the North, imparting to the scheme of solid lands a pyramidal shape, the fundament towards the North the apex towards the South.

The ocean streams flow towards the North but in their passage they encounter opposition from the widening continents, from whence arises a tendency for the water to force its way inland. The perpetual pressure and friction of these liquid masses forces a passage through the earth and water finds its way below into the burning bowels of the earth, producing seismic phenomena.

If the crust of the earth in the spot penetrated by water is thick and the source of the water not very abundant, a simple earthquake ensues which, cracking the earth's surface in certain places, forms in that way an outlet or filter through which passes the subterranean vapour; but if the force of the underground vapour is very great, it drives out streams of the burning lava from within the earth by means of volcanic eruption accompanied by local earthquake. This independent heat of the earth, so clearly shown in these phenomena, must of course act more or less upon our gaseous atmosphere. The more energetic the planet the more developed and the greater its animal caloric, acting on its vegetation; so that the scientific assumption of 80° of cold[1]) on the planet Saturn is the purest invention without any data to support it which can be gathered from the study of the solar system.

In the case of eruptions on islands or the shores of seas a further local phenomenon is observable, namely the tidal wave, which owes its origin to the upraising of the earth's surface beneath the water by the accumulated vapour below. The coast waters are rolled back by this upheaval upon the interior waters of the sea basin, and return with elastic force towards the land when the sea-bottom subsides after the dicharge of the expansive vapours through the volcanic crater or the seismic cracks. This return of the tidal wave is attended with disastrous and destructive consequences to the coast districts in the neighbourhood of the volcano or earthquake.

[1])—148° F.

On the island of Java during an eruption of Krokatao more than 8 towns and 40 villages were washed away in a few minutes and more than 40,000 inhabitants perished. At such times everything in the sea within twenty or thirty versts of land is also destroyed. Vessels in the harbours are left stranded, and masses of fish struggling and leaping and wriggling lie on the dry sea-bottom — all to be borne with destructive violence landward by the incoming wave and shattered to pieces on the resisting rocks.

There is again a notable analogy between these volcanic waves and the common tides, just as there was a marked connection between the thunder-storms of the Tropics and the Aurora Borealis of the Poles. As in thunder and lightning electric force manifests itself in storm, so also in volcanic tidal waves we see symptoms of an abnormal condition seeking relief. The Aurora Borealis on the other hand is a calm electric phenomenon pointing to a peaceful condition of the elements, and the daily ocean tides are not less the product of a calm normal sustained upheaval and subsidence of the marine basin. And thus the volcanic tidal waves serve as another link in our chain of evidence; we can gather from them still further confirmation of the idea that not any attractive lunar or solar force but a respiratory action of the ocean depths produces tides.

No doubt our earth like all living creatures breathes oxygen gas, for only under such a condition can we account for the burning central fires of the globe, so clearly testified by the fierce flames of volcanoes, and the progressive rise of temperature as we descend through the earth's crust towards its centre.

And so we see that there exists a technical connection between ocean streams and volcanic eruptions; we see that the one phenomenon produces the other. Naturally we ask ourselves what is the significance of this connection? the phenomena themselves will supply the answer to this question if we study them carefully.

The town of Pompeii which at the time of the eruption of Vesuvius stood on the sea shore now stands back quite a quarter of a mile from the coast; on the island of Java, especially rich in seismic records, there are cases of coast towns which now stand eight or nine miles from the sea. Such have been the results of organic eruptions, owing to the mass of matter — ashes and cinders with pumice and slime thrown out from the craters, which has united and formed firm deposits. It is evident therefore that volcanic action is an effort on the part of the earth to widen solid surface at the expense of the watery waste; in other words an effort to effect the gradual desiccation of the globe.

Ocean Streams.

The ocean streamo are another instance of the exchange of cosmic matter. Under the pressure of the cosmic tide the waters of the South Pole flow towards the North from whence they return in subaqueous currents. These two opposing currents are clearly distinguishable in the Caribbean Sea near the coast of North America, where the upper current can be seen flowing in one direction and the lower current in another and opposite. In the profound depths of ocean the same process is unquestionably going on, otherwise the South Pole would long since have been swept bare of waters, while the north would have been completely flooded.

This movement of ocean waters cleanses the earth, delivers it from stagnant water and its putrid accretions, and besides climatic influence aids the multitude of marine creatures in their transmigrations and promotes the extention of the vegetable world so indispensable for cosmic purposes. That beside the visible currents from South to North there exists submarine currents running in the opposite direction is shown by the enormous area of water flowing North and the narrow streams flowing South. Obviously the mass of waters must go somewhere and since the South Pole notwithstanding cosmic pressure is rich in stores of water we can see that it is supplied by returning streams from the north.

For the North Pole the ocean streams are needful to break up the floes and fields of arctic ice, and by that action to aid the vital organisms in arctic waters. Being as I said removed from the influence of cosmic pressure,

the North Pole would be a kingdom of motionless death furnishing no possibility of organic life without some external aid. Such a result would be a contradiction of cosmic laws of life which is a forward movement shared by entire organisms, and admitting of no premature and partial decay.

A clear evidence of the double ocean currents is afforded by the transmigrations of fish living in shoals. Some of these fish, such for example as herrings and cod, annually migrate for breeding purposes from northern seas into warmer waters. Their passage is always effected against the marine current and is evidently directed from the far north to the south, stopping at the shores of France, Germany and Scandinavia, in the European waters.

After spawning, these fish at once disappear, and only next spring repeat their transmigration from the North. Evidently they return by the submarine current, and as they always swim against the tide their journey northward is no doubt conducted through a current running south beneath the superficial stream.

Once more we see here the reason of nature and notice the analogy between aqueous and atmospheric currents between the movements of the fish in the sea and the movements of the planets in our solar system.

The cosmic tendency of the planet worlds.

From the scheme I have expounded in describing the solar system it is now evident that the efforts of the planets are directed to their conversion into suns. In the heavens as on the earth the family is the ideal of individual life. Let us look how this ideal is attained.

The infant asteroid being new-born of a sun, is incandescent and its first aim is by cooling to prepare itself for cosmic life. Oxo-hydrogen assists it in this effort by surrounding it with heavy vapour clouds. The spectrum of the little orb must consist of lines of hydrogen, oxygen and nitrogen.

When sufficiently chilled a tendency to develop vegetable life begins to operate and a life of cosmic service commences: the little planet becomes a moon, acting as an electroid to the larger sphere with which it carries on exchange of matter. First it receives from this sphere the germs of that vegetation which it sustains by its electric light, and with these seeds the insects which promote their growth; and then as water is the vital food of plant-life, the seas and lakes are the first planetary nurseries.

The planet-moon remains an electroid of some larger world until firm continents are formed upon its surface—continents covered with vegetation: it must live through its age of water-weeds and aquatic animals from animalcule and sponges up to crabs and large-sized fish; its

amphibions age leading to the birds; and all the remaining ages of evolution preached in Darwin's theory of natural organic selection, right up to earth-walking quadrupeds.

The work of founding and elaborating his theory of natural selection must have proved no easy task to the English savant. I remember one little episode in his labours which occurred at the time when he had prosecuted his pursuit of the evolution of species to the step between the amphibious creatures and the birds. The passage from the one to the other class was clear to him, but in his zoological collection he had no example of visible transition state between the leaping amphibia and birds of flight. For many years the scientist remained worried by this missing link, though all his best friends were scouring the earth to find it. But on a certain happy day one of his colleagues in this search, working in S. America, reported the discovery of a flying lizard. Of course this priceless specimen was placed without delay in Darwin's English collection, and the great scientist long rejoiced over his treasure with childish glee.

And now I clearly see the position of the moon with its surface of water and mountain peaks. To plant vegetation on these peaks it was necessary to fly up from below, and such flight only the winged birds can accomplish. Flying up they sit upon the lofty mountain tops, carrying their prey thither, and with it vegetable seeds which, nursed by the vapours and the mists, fertilize, and extend their roots into the rocks and roll their fruits into the valley.

The spectrum of the electric lamp and the spectrum of the moon must be identical.

The natural effort of every planet is to become a double star and afterwards a sun, and this transition occurs in the case of solar planets quite simply. The more energetic, travelling in their orbit overtake the feebler and unite with them, if no natural obstacle pre-

vents; but in what manner precisely this uniting process is accomplished it remains for astronomers to discover. I assume that some vital connection attracts them to one another.

A solar satellite must perfect itself; it must dry; it must extend its surface of land; for this purpose the animal kingdom is developed and evolves as an organ of spherical culture, being entirely subordinated to the cosmic requirements of the time.

The spectrum of solar planets must be unbroken.

The first animal organisms must approximate to the birds and the amphibia; after them leaping creatures must appear-since the primitive valleys must be intersected with waterways, rivers and ponds. The pachyderms follow, creatures with skins adequate to resist the prickly growths and force a way through the trackless depths of aboriginal forests; while the open valleys would form the breeding ground of more peaceful species, whose nature would lead them to spread abroad the planetary flora: as such appear undoubtedly the herbivorous quadrupeds.

The omnivorous fauna serve as a medium between the valleys, the mountains, the bogs and the forests of this early age. The carnivora judging by their loud voice, swift movements and undeveloped stomach are andoubtedly a product of the wilderness, whither they unconsciously bear the seeds of vegetation.

Generally speaking if we follow the history and specific developments of the animal kingdom we shall trace the profound wisdom of nature. Why, for instance do lions roar and serpents hiss. When one only looks at the conditions of these creatures' lives the riddle solves itself. Serpents live in cracks and crevices and caves, seeking in these retreats their young ones' food. If on catching their prey they cried cloud in open air the little snakes, hidden away would never hear, and the cry itself would betray the serpent's presence and give warning of its approach: its victims would hide and save

themselves, and the voiced snake perish for lack of food; and afterwards, in natural course its young would die. On the other hand the hiss of the serpent, inaudible or slightly audible in the open air, vibrates far and wide amongst the rocky recesses, and guides the young to their parents and the parents to their young.

In the same way the lion, the king of the desert, living in his wilderness dominion encounters beasts as swift as he himself. In pursuit of such prey he wanders many miles from home, and when at last he catches his victim he cannot bear it back, for his whole organism is unfitted for that task. But with his thunderous roar he summons his family to their repast from afar.

In the voice, the character and all the details of every animal is well expressed the deepest natural reason which, though apparently only concerned with the life of the particular creature, is in reality merely regarding that life as an agent of cosmic and planetary culture.

Probably animal life, as we know it upon earth comes to an end on double-stars, inasmuch as the spectral analysis of these stars passing through all the colours up to the solar colour, tells of an increasing heat inconsistent not only with human life but with any conceivable sort of animal existence. It may be however, that sun flame itself is a product of some organic microbe. Typhus bacilli raise the temperature of a man lying in bed without exertion or movement six or seven degrees; why may there not exist a solar microbe—the more since the solar rays, on reaching the planets exercise a vivifying influence on these worlds and produce cosmic energy?

The spectrum of double-stars is, as we saw, most varied. The solar spectrum is of yellow stripes with black lines. The spectrum of extinct systems i. e. cosmic cloud, is formed of the lines of the hydrogen, nitrogen and oxygen. Comets in the nature of things, have no light excepting when they fall beneath and reflect the rays of a sun; consequently they supply no spectrum.

In studying the spectral analysis of the starry spheres one is forcibly struck by certain phenomena. The asteroid, starting existance with the lines of hydrogen and azote passes through all the spectral colours and finally sinking into ruin and cosmic cloud concludes its career with the same lines. How this reminds one of human life, commencing and ending in helplessness and dependance upon others?

The atmosphere of the Earth.

We have been engaged in examining various cosmic phenomena which take place in terrestrial atmosphere, and the question what is the nature and function of that air can now no longer be deferred.

Scientists are all agreed that atmosphere consists of four gases -- azote or nitrogen, hydrogen, oxygen and carbon; but my assertion is that besides these gases remain three more, hitherto unrecognized; elements corresponding to the sense of conciousness, sight and catalepsy, signifying by this word the loss of sensation and consciousness experienced in sleep and swoon. If this is so the total number is nature's strange symbol—séven.

When we begin to analyse the nature of atmospheric gases we see easily that our earth's air is fundamentally nitrogenic. Azote presses on the ground with a force of 16 lb. to the square inch; azote is the cause of the winds; azote produces the barometrical maximum and the barometrical minimum; we are indebted to azote for the exchange of matter upon our planet; azote builds up the vegetable kingdom, in a word everywhere on every side we are supplied with evidences of the fact that this gas is the chief factor in all the productive force of our atmosphere.

Scientists recognize in the nature of our globe an intrinsic centripetal attraction, and it is only when we examine the natural conditions of nitrogen gas that we begin to doubt not only the necessity for but also the existence of the centripetal principle in nature. We have seen that azote builds up the vegetation of the earth,

which is the laboratory of solar oxygen. We have seen too that barometrical maximums and minimums, thunder and lightning and rain are also products of the rising aud falling and heating and cooling of this same azote. Still further we have seen that the cosmic language of light is the result of friction against the surface of azote. And now we see that azote presses on the earth with a force of 16 lb. to the square inch, a force which is sufficient to preserve the earth intact without the aid of any centripetal gravitation.

I look upon our earth as a vital organism and consequently look for the analogy to her vital functions in those of the vital organisms around.

Every living being has a bodily form adapted to environment; organs of movement, of nourishment of sight or sensation, of circulation, and an external covering, skin or scales or slime; but no inherent centripetal force is to be remarked in any living organism, large or small, with which I am familiar. Cut or tear the skin of any animal and you will see that the blood and lymph and entrails pour out and manifest no tendency to return: and only the pressure of azote restrains the flood which if not checked continues till the creature dies.

The same can be said about our earth. Volcanic eruptions, breaking through terrestrial centripetal force should fly out into space beyond our atmosphere; but instead of this the lava torrents fall back upon the earth, pressed down again by the force of nitrogen, and oxygen completes the work by forming them into soil. In this case therefore azote preserves the earth from loss and change. With such a force as skin or envelope no centripetal gravitation is required; and if it existed the movements of living creatures on the earth's surface would be, if not impossible, attended at any rate with the greatest difficulties.

Azote, being a gas, presses on all sides equally and therefore movement in it as in a fluid of great rarity,

answers to a very insignificant opposition whereas a centripetal force of attraction being more or less magnetic, must act with noticeable difference on raising the feet from contact with the earth. Every-one must agree that if the alleged central attraction was so powerful as to maintain the animal creation on its legs in relation to the sun feet upwards through the night, its force could not be by any means a negligeable quantity but must exercise at all times a most imperative control over our actions. A man lying flat upon the ground in order to rise must overcome, a force ten times greater than that which he resists when standing on his feet. But in reality the pressure which binds us to the earth is of another kind, the pressure of the atmospheric nitrogen into which we were born, in which we live and out of which, as experiment within the earth's crust and above the earth's clouds has clearly proved, we cannot manage to exist. Sinking too deep the pressure is too strong; rising too high it is too weak; there is too much azote or too little; and human organisms — notably the aural organs, skin and mucous membranes—suffer.

The next question is: Does our earth need this atmospheric envelope; and if so, why?

Of course our atmosphere is needed. The earth moves in space at a speed of 28 versts a second, and, besides this circular forward movement, rotates around its own axis. The motion of its surface equals 30 versts a second.

In earlier chapters I showed that the universe is full of oxo-hydrogen. Suppose for example that the speed of a hurricane is equal to one verst a second—can we imagine the consequences to our earth of exposure to a current thirty times as swift? Nothing would remain on the surface of the globe and the planet from a sphere would become a spindle. The first and chief function of azote is then to preserve the earth's outward form. In this respect it reminds us of the mucilaginous coating of a fish. Fish by the natural conditions of their life have often

to pass through narrow and difficult places in flight or in pursuit. Were they not defended by their scales they would be subject to perpetual wounds. The scales act as armour to protect from blows, but they themselves might easily be torn away, leaving the body naked, but for the special mucilage which cures the injured parts and renews the damaged scales.

Besides preserving the earth's form however the azote defends the earth from cosmic matter. It is computed by scientists that not less than 5000,000 ærolites and other such cosmic fragments, bearing the name of shooting stars fall every year upon our earth. These elements only become visible to us when they enter our atmosphere, from one hundred to a hundred and fifty versts above the earth's surface. Cases have been known of such bodies which seemed on their first appearance as large as the moon, and an object which at a distance of a hundred versts appears as large as the moon must weigh at least millions of poods. Such a mass crashing upon the earth at full speed would produce terrific results. Certainly if for entire versts this mass was breaking into pieces, and every year five million visitors of this sort big or little entered our air; the earth would be no place to live in. But nature foreseeing this provided in azote a shield. As soon as the ærolite flies into our atmosphere it encounters the stream of solar gas flying upward, the friction against which engenders enormous heat, a long line is described by the burning meteor and the hydrogen which is freed from the combusted oxygen tears its opponent into fragments and the ærolite explodes and falls to earth in cosmic dust, swelling the body of the earth. The function of azote in this case is very clear; it acts as a buffer against the cosmic ruins floating along upon the cosmic tide.

Examining all these conditions of cosmic life we see everywhere the signs of reason, deepest and clearest wisdom, in all the atmospherical and celestial phenomena of stars, and cannot but be astonished at the limited one-

sided views of creation commonly accepted in the world of science. Newton, astonished and charmed by the grand harmony of the heavens, recognized as the ruling law of celestial movement the principle of gravitation, and ever since this mere hypothesis has held astronomers in chains and been a burden on our youth. Abundant theories about radiant solar force, have been formed, and the solar rays have figured in this form and in that; but our entire scheme of cosmography is mere hypothesis declared as gospel truth; and many unpleasant experiences fall to the lot of scholars and their parents from the difficulty experienced by the former in comprehending these scientific fables. But think only, if we, little creatures of an hour, can live a reasoning life on earth amongst ourselves, why should we deny reason to the collosal beings immeasureably more powerful and more during than ourselves —who by their life and their magnificance adorn God's Universe?

Man as the Earth's servant.

Man is the last and most perfected product of our mother earth, and it sometimes seems to us that as a higher creature endowed with intellect and freedom of the will his action is unrestrained, he can live as he lists and follow implicitly the dictates of his own desires. But when we enter into the real meaning of human life, and into all the circumstances surrounding it, we see that we have before us not earth's master but its slave — a creature entirely dependent in its feelings and its will.

I will try first to deal with the phenomena of human feelings.

Though physiology teaches that man possesses only five senses, I shall endeavour to show that, consistently with the ground plan of the natural creation in which we everywhere trace the number 7, but nowhere the number 5, the number of the senses is not 5 but 7.

1) Consciousness is the vital harmony between all the parts of the human organism founded on the appearance of capability to exercise the functions of independent life. The various parts of the human organism consist of mineral salts and atmospheric gases which, entering into the composition of the organism in certain chemical proportions, form the whole indivisible living body of a human being: consequently the original elements of man are products of earth; bone of her bone and flesh of her flesh.

2) Together with the first awakening of consciousness man acquires knowledge of the seents in surrounding

nature, scents which produce in him certain sensorial requirements similar to those which earth itself manifests. The earth as a planet is a laboratory of oxygen for the sun, and we ourselves see that everything which contains oxygen in abundance acts refreshingly and agreeably on the human organism, and man is unconsciously attracted towards the flora of the earth, instinctively running from all that presents itself as mere dead remains in process of putrefaction. Actuated by abhorrence of putrid stench, he buries away under the ground this objectionable matter, and as the earth is nourished by dead refuse of cosmic worlds, soon after the surrender to its keeping of human refuse it throws out, as though in gratitude, new forms of vegetable growth, with sweet-smelling flowers, as though to teach man how to earn in place of unpleasant and unwholesome smells, fresh, healthy, aromatic air so indispensable for his own health and energy.

3) Together with the first vital activity of the human organism appears the sense of taste. The frame of a living man naturally demands continual renewal of decaying parts. His nature experiences hunger and demands food as fresh material, the consumption of which food rouses the distinguishing sense of taste. One food is tasty, another the reverse; one satisfies, another does not. Moreover at one time one food, at another time anothere seems the more agreable, the appetite indicating in this way the substance most needed by the frame.

4) Sight now follows. The first three sensations were the manifestations of the internal organic needs of man, but in sight a connection is established with the outer world. Looking out into space, the human creature, thanks to this faculty, learns to understand at a glance what places are and are not suitable to inhabit, what animals are dangerous and what harmless; in a word how and when and where he must guard his own safety and welfare.

5) Hearing—the aural manifestation of the surrounding world — enables man to select the safest conditions, to avoid danger. The approach of an enemy, the proximity of some natural plague, the nearness of kindred creatures, these and other such things are often revealed to us through the ear.

6) The sense of touch is given by nature to enable man to distinguish by outward contact the nature of objects around him and of their action on the human body. By experience he learns the value or danger of these objects and he develops a conscious understanding of what things to seek and surround himself with and what things to defend himself from.

7) Finally catalepsy or swoon, a special form of vital function when all sensations die away. This may be a natural temporary pause as in sleep, when the tired organism demands renewal and the 'ravelled sleeve' needs 'knitting up'; or it may be the outcome of disease when the suffering nerves overcome the muscular power and, acting on the brain, produce such a pressure there that the organs of the body lose their blood supply; or in the last case, it may be death, the final cessation of all life and action.

In every one of these seven senses man lies under the immediate control of nature on the earth.

But further it seems to me that not only our senses are seven but the atmosphere we breathe consists not of four elements but of seven. Every sense I assume corresponds to some atmospherical equivalent, one gas prevailing over others. I trace this connection as follows:

a) Consciousness corresponds to a moving force which produces harmony between the gases and the salts forming the human body.

b) Smell corresponds to the power of oxygen.

c) Taste corresponds to the action of carbon.

d) Sight corresponds to a transparent medium which, like the element of consciousness, remains till now unknown.

e) Hearing corresponds to hydrogen which develops sound-waves.

f) Touch corresponds to the power of nitrogen, the constructive gas which imparts form to every living body.

g) Catalepsy corresponds again to an unknown element which suppresses and stops the vital action of the gases in the human frame.

Hence I assume that there remain three unexplored elements in our atmospherical gases, elements corresponding to consciousness, sight and catalepsy, whilst the work of the remaining four is clearly reflected in the action of the senses. Let us look at the manner in which they act.

In breathing man inhales nitrogen, oxygen and hydrogen, and exhales carbon, vapours and azote. Only the element of oxygen suffers material change, being dissolved in carbon and in vapour. Breath is also the source of smell and therefore oxygen is obviously the primary gas concerned in this function.

The sense of taste is in direct proportion to the quantity of the carbonaceous element contained in the food. The latest medical researches have shown that a sick man can survive and recover upon a carbon diet whereas upon nitrogenous diet he will perish. From youth to age berries are a favourite food, and they especially abound in carbon. On the whole we can conclude that the most tasty and useful foods are those containing most of this important element.

The sense of hearing is directly proportional to the hydrogen waves reaching the ear. Every sound heard in nature is caused by the separation of hydrogen from combination with oxygen, the separated gas flying out with all its characteristic rousing energy to seek some vital service.

Take for example the ringing sound of a bell, what occurs in such a case?

From the blow of the tongue the oxygen combusts in the place of concussion and the liberated hydrogen causes the walls of the bell to tremble. The motion produces new friction and combustion and the freed gas spreading in the atmosphere produces the phenomenon known as sound-waves.

So far as concerns the sensation of touch it is evident on the face of it that only forms of matter having a certain firmness can be touched, and such matter can only be produced with the aid of azote; whence this gas appears to lie at the root of this phenomenon of feeling.

And if every separate sensorial function of man is wholly dependent upon the atmosphere around, it is hardly open to doubt that man himself in his entirety is subject to its power. The free-will which he can exercise in moving from place to place is strictly confined to the limits of planetary service. As vegetable seeds are carried in space and grow upon that soil which suits them best, so, exactly, man seeks for himself the best environment in which to come in touch with nature and develop the best fruits of knowledge. The bosom of nature is the most suitable ground for mankind — his natural soil; it furnishes vitality, health and longevity, and the least attention to the statistics of human hygiene will show that the villager is healthier than the resident in towns.

Our earth is striving, like the other planets to become a sun, and to achieve this end it must so far undergo the process of desiccation that oceans and seas and lakes must disappear. Man helps with this work; he dries up the bogs and rivers; he battles with the seas, as we see in Holland and Normandy; he cultivates fresh forms of vegetation and makes use of all the animal creation. Man clears the forests and ploughs the forest land, not as a mere human fancy but because the grass and corn give out more oxygen and furnish him more food. Man breeds

flocks and herds of herbivorous creatures and milch cattle not for their beauty's sake — what can be uglier than a cow?—but because these creatures advance the culture of the earth, supplying more nourishment to the ground than other animals, and yield food beside wholesome and nourishing to the human frame.

The punishment of man for neglect of the cosmic laws.

Of all the animals upon earth man appears unquestionably the best executor of its will. As a creature leading a social life he is best of all able to defend himself and to arrange for the continuance and extension of his species. In this direction the earth itself lends him its aid. Look for instance at all those human actions which embody tendencies destructive to the race: the earth itself rises in all its potency against such, and gives man to understand how repellent to her these are. For example what can be more immoral than war, in which all laws human and divine are trampled under foot? And here we see with ten or twenty thousand slain on the field of battle, five or ten times as many perish from nature's wrath through visitations of disease — dysentery, cholera, plague and other infectious scourges. The earth as it were arms itself against murder, and mows down the man who lifts his hand against a brother man. The same is observable in every-day life. In consequence of slovenliness men sometimes dwell amongst masses of decaying refuse, and in those cases sickness is not slow in punishing the offender. But of all such instances of disorderly life none prove so promptly prejudicial as those in which the living dwell amongst the dead — an infallible cause of epidemics. Plague, the most awful of diseases centres chiefly round the Indian cemeteries and is certainly of grave-yard origin.

In India the rich are not buried in the earth nor thrown into rivers as is done in the care of the poor,

but whole colliseums are erected in their honour and their corpses are laid out on couches at the top of stairs, and are wrapped in black robes or shrouds to enjoy their everlasting sleep. Of course the first visitors are birds — ravens, rooks and others which have a taste for meat — and these peck away the flesh. But the marrow in any case remains and decomposes at leisure, permeating the air all round; and sometimes the pelting rays of the sun rot a whole frame before the birds can eat it and the pestilent effluvium poisons the atmosphere and does not spare the living, who perish in their superstitious pride. Outbreaks of plague originate in this way in the neighbourhood of such burying grounds.

We see a similar phenomenon whenever and wherever men decline to fulfil nature's laws. Just as a fruit for the development of its seed must be sunk in the ground or it will rot and die, so must mankind on attaining maturity unite in wedded pairs for increase of the race which best can help the earth to desiccate and spread its continents and dry its oceans. Sooner or later all water must disappear from the globe into space in oxo-hydrogen, and man is a chief agent in this work. And when man refuses for reasons or from force of circumstances to fulfil his destined function and extend his race, the sins of youth are multiplied and an evil crop of moral results is reaped in nervous illness, various diseases and sometimes death: if then, instead of natural union in pairs dissolute intercourse is practised, future generations suffer specific penalties, and the offender himself is given up a prey to an unhealthy frame and an unquiet conscience.

Unfortunately of late so many different opinions have been expressed regarding marriage that it is difficult to consider them all in detail. It has become customary to marry young peasants at 18, to settle them down in life that they may fill their proper place in village affairs, but a man aiming at higher education, and consequently well understanding the laws of natural science, is for-

bidden to think of marriage or to dream of the other sex at such an age. Marriage is for a youth of this class a still distant prospect. He has to finish his scholastic course, to obtain some good appointment, establish around him a certain degree of comfort and opulence, and then only is privileged to think of wedlock; as though the essential condition for matrimonial fitness consisted not in sexual maturity, but in the comfort and luxury of wealth; as though the chief requirement was that the wife might sleep on down and feast on dainties, and be not her husband's help-mate and house-wife but a delicate doll serving as her husband's toy. No, if marriage is a mystery in which the partners are so united, body and soul, that in the language of the church "a man shall leave his father and his mother and shall cleave unto his wife", there is no place for troubling about comfort, but place only for labour and energy of individuals in promoting and perfecting nature's work on earth.

It is to be regretted that this false philosophy infects also women. Though less obedient, woman receives these counsels with respect and utters no protest, whilst the refusal of the right to marry at the proper age rouses unceasing protests from the men.

Any boy of 16 if his health is sound is infallibly in love, simply because the human seed of the healthy organism develops sufficiently between the age of 14 and 16. In the country among village folk this is well understood as a common-place natural fact. There they address such boys plain advice and warning. "Wait a bit, Jack; God grant you'll pass your seventeenth year and we'll marry you, and you'll set up your own house and home with a young wife". And Jack waits willingly, knowing that till he is eighteen no priest will wed him to any girl. He sees in this simply a law. But is it so amongst educated circles?

Instead of looking upon marriage as an inborn natural need of the human organism, pedagogic morality sets up a hue and cry — "What's this you are thinking of?

Brat! Still in his teens and falls in love! Better attend to your Greek and Latin lessons and leave love alone". And even that is lucky, if the matter ends in words. The lad crushed in his first amorous desires by the authoritative denial of his parents, forbidden to utter a word upon the subject, seeing no prospect of release and freedom, buries his secret in his own bosom; like a snail in a shell shrinks into himself. But his is a shell which opens and closes — opens to the first convenient call, and the youngster reveals the tenour of his thoughts. And as this cannot be done where it should, it is done where it should not, in circles where people live more freely and nearer to nature; in the kitchen, on the street the doors are open for the novice and he enters in his innocence in response to voices which seem the echo of his nature. It is easy to imagine how false and mistaken his idea. Whilst in his young heart this lad is idealizing woman as the perfect mirror of his finest dreams, the best and highest gift nature can bestow on him, with whose help he may hope to form a strong and healthy family of his own, the denizens of the kitchen and the laundry and the street are disenchanted beings without faith in ideals, whose primary thought is of tomorrow's meal and how they can best exploit the inexperience of youth. On the one hand the timid but insistent demands of youthful nature; on the other the brutal equivalent — two three, five roobles. The suggestion at first not only offends, but astonishes; the youngster knows not what to do, but to avoid offensive reminders he strives his utmost by punctual payments to escape all further humiliating mention of his bargain.

The question arises — where to get money? How to keep the sky clear of clouds? And this urgent and secret need results in gradual descent. Resort must be had to tips and presents, stories of fictitious requirements must be invented, loans and trickeries follow, and the history culminates in theft. The ideally moral youth descends into the dirt of falsehood and deceit and crime

simply because his parents persisted in regarding the natural claims of manhood and maturity as childish nonsense to be beaten out of boy's heads by diplomas and Greek classics; because they lacked all sympathy with him and failed to persuade him to await the proper time when the law would recognize his right.

It is strange that in the plain uneducated peasants family this early marriage is a common circumstance and a popular event in the domestic circle, whilst amongst the upper and more educated classes this same early marriage is considered foolish and next door the criminal — and that, notwithstanding the abundant proofs of the mischief done by the influence of the latter view.

I say abundant proofs and I do not exaggerate in stating that the mischief wrought by these opinions is immense.

Our kitchens and our streets are never specially distinguished for purity. The inexperienced youth soon has his eyes opened to the fact that not he himself but his purse, slender though that may be, is the object of desire in these spheres. Not rarely he has the satisfaction of finding that this purse and all his strenuous discreditable costly efforts to refill it, have been sacrificed not for the benefit of his fancied flame, but in the interest of some insolent big-fisted bully long already accustomed to exploit all the resources of the woman subjected to his power.

The ideal is thus irremediably smashed; but as nature's physical demands have found a source of realistic supply, and as the appetite of health grows with the food it feeds on, these physical demands are soon deprived of all their moral meaning and woman becomes for such a youth a thing, a beautiful apparatus as it were, for the discharge of electric energy and relief of desire.

As soon as this change has taken place and a man looks upon woman only in this way, the fountain of all sorts of nervous and sexual disorders is fairly tapped.

The stream grows fuller and fouler as it flows; the course of immorality widens when a young man leaves his parent's home and lives at liberty alone. Enter the collegiate homes and furnished rooms in which our youug students mostly live, — how many suspicious medicine bottles, and medical prescriptions of a certain sort you will find hidden in drawers or lying out on window-sills!

The troubles of these young sinners are the sorer from the extreme obstinacy of sexual diseases, and from the powerfully noxious influence of such maladies on the psychical nature of the sufferer. Cures are wearisome and superficial in most cases, and the patient continues in constant dread lest nature's scourge should leave some outward mark drawing attention to his state. For the future, the sinner promises himself he will be more cautious.

But this practical resolve remains a pious dream. Drawn again into the hustle and bustle of life he soon forgets his recent illness and his late resolve. Physical symptoms reappear from time to time, but the doctor's ointments clear them away, and the vicious course continues until destiny drives him into matrimonial toils. I intentionally use the expression matrimonial toils, because these late marriages are always the product of some calculation and built upon protection, financial need, inconvenient results of illegitimate intercourse, or resistance on the part of the woman to illegitimate advances.

At any-rate we will assume that the marriage has taken place, and that relatives are expecting from it the natural fruits of union — a child. The period of pregnancy arrives in due course, and this, as is always the case, produces vast excitement and interminable preparations: a whole dowry for an unborn bride, or full accoutrements for a future hero. But lo! one fine day when no one is yet expecting the event, that event occurs. Doctor and midwife are summoned in mad haste;

and into the world is brought no living child but an abortion.

It is vain to rebel against destiny, nevertheless a full enquiry begins into the causes of this miscarriage. It is discovered that a month before the mother slipped and fell, or a week ago she struck against the corner of the bedstead, or the day preceding the disaster she went to buy some flannels for the child and coming home walked upstairs to the third storey.

Great is the grief and numerous the lamentations of grandfather and grandmother and the father himself, but in all their attempts at consolation one hears a note of protest almost of reproach, against the mother, who as it were lacked the needful zeal in the family cause; and the poor woman bears this meekly, thinking only of how she may escape the like mischance next time. How careless was I, she thinks, not to have guarded properly my little Victor! The future conqueror! Oh certainly he would have conquered everybody and everything had he but been born!

It is remarkable that the first child of an unhealthy father is almost always still born. But passing over this misfortune we reach at length a second event.

Two months before the expected end the sick mother is sent to bed and lies there, mostly on her back because it is a medical dogma that without such precautions a first miscarriage is likely to be followed by a second. And so at length after a prolonged term of recumbent suffering a living child appears. Everybody expects the little stranger to come among them a phenomenon of health and vigour; and indeed it is more or less a wonderful creature which sees the light, only not wonderful in the desired sense: the infant is restless and feeble and sickly, a harbinger of suffering and sorrow rather than a promise of joy. The poor mother lays it to her breasts, presses it to her heart; but the little weakling yields but faint response. One week passes, two weeks pass — weeks both of sleepless anxiety —

and suddenly instead of fresh rosy skin, appear scabs which convey contagion to the maternal teats; the mother sickens and can no longer feed her babe.

Again follow great discussions in the family conclave as to the how, the why, and the wherefore. The infant is given to some wet-nurse, and its career is a course of medical treatment from the start, a speedy death being beyond doubt the kindest fate. If it remains alive it grows up into a scrofulous ruin like its father.

From time to time these births are repeated with the same melancholy results, driving the innocent mother to distraction. She wonders for what she is so scourged. Others she sees have healthy children; why not she?

The desire to have children becomes especially powerful after a woman has passed her twenty-fifth year. I have indeed remarked cases of very loving wives surrendering to intrigue about this age in hope of offspring. And this unhappy mother whose sickly children we have seen, naturally cherishes the dream to have at any cost a healthy child.

She observes what others do in such a case and follows their example. Another pregnancy encues and another child is born; and this time her most painful doubt hangs on the question — Whose it is?

But she has resolved already to dispel this dread ful doubt at any cost and to effect this end resorts to wild expedients. Whilst carrying the child she remembers that her first miscarriage was attributed to falling, striking the bedstead, walking upstairs; and inspired by a sudden idea that all these suppositions were mere nonsense and the real cause quite other, she puts this notion to the test, falls twice instead of once, strikes three times against the bedstead, and instead of only walking upstairs carries heavy parcels from a shop. Her doubts little by little are allayed; she begins to feel the harbingers of happiness and finally the birth occurs.

Two weeks pass; the breasts continue without pain; no scabs appear; the infant whitens in due course: smiles on the world; utters its natural cries; laughs loudly, and bye and by begins to lisp "papa! mama!"

The joy of the family can be imagined, the old folks buy toys and sweets; the father, depressed by the sins of his own youth and the sufferings of his spouse, prepares himself to accept and to amuse the little stranger. As to the mother she is like a child with excess of happiness; pinching and tickling the baby until it crows with glee, kissing it with open mouth as though to swallow it with kisses. All around in the family circle reigns jollity and merriment and laughter merely thanks to the appearance in its midst of this one healthy child, the future world-worker and helper in the execution of the cosmic laws.

The question arises -- under such circumstances wich is more wholesome and more moral, matrimonial fidelity resulting in a generation of miserable weaklings, or adultery crowned by family felicity? I fear that this question is easily settled in favour of the second alternative and am forced to confess that the fashionable views on early marriage not only fail to rescue the young from immorality and financial ruin, but distinctly drive them in that direction, producing a state of affairs in which, both physically and socially, conjugal infidelity becomes of use to the community. Not early marriage is the root cause of evil here but our social ignorance and slavishness, which renders marriage union a state from which there is practically no escape.

Men of a certain superior moral class and training are willing to bear tenfold more from their partner in life than they could bring themselves to inflict; others of a rude and overbearing sort rejoice in domestic bullying, and act as insufferable tyrants in their own households, the members of which, especially the poor wife, live in terror, and either seck protection from strangers or take refuge in flight.

In marriage our church blesses only love, and even only such love as can impel a man to 'leave his father and his mother; and without this love the ceremony of marriage is a mere form the dissolution of which as a legal tie should be rendered as easy as possible.

Another and co llateral question is that of education. The divine dictum 'do unto others as ye would they should do unto you' is the fundament of all right education, and hence the chief aim of the community in this matter should be to develop in the citizen a sense of his fundamental communal duties of humanity and morality, and together with that the common elements of school learning. Government not only has no right to deny its citizens the privilege of education but it has a clear duty to demand from every father of a family that he should send his sons to school and supply them with a broad humanitarian education, founded on the principle of love to one's neighbour and on knowledge of the natural laws of life.

I have drawn two pictures of family life: the one when a man enters the marriage state on attaining full puberty and maturity; the other when a man leads his early manhood in a state of unblessed singleness in the company of low and unsuitable companions, only in later years offering the ashes of his fires to the partner whom for various and mixed reasons he may select. But it remains to remark that not always even in later years do men of this latter class select a wife at last. Many pursue the sins of youth into old age, and losing health and faculty die in madness or premature decay.

As to the old maids I am modestly silent, remembering the old saw — 'an old maid is more malicious than the Devil'. Enough may be gathered from the mere existence of such a saying.

It may be objected that if young folks do wrong and suffer for their deeds they are responsible for their own misfortunes and the laws of nature are outside the question.

It would seem so indeed, but I ask why do none of these evil consequences ensue from early marriages? These consequences arise only from indiscriminate intercourse, and from this they ensue notwithstanding all precautions, and are carried by the simplest forms of contagion into the bosoms of families entirely innocent of moral transgression.

In any case, however we explain this disease, the fact is certain that it almost invariably presents itself as the punishment of immoral relations and neglect to establish an early family. Nature demands neither forms nor ceremonials but it demands the fact of an early and firm union, and complete devotion of two individuals; and this state of normal intercommunion is the highest humanity can reach.

As to marriage forms these take different shapes in different nations, and the well-known philosopher Benjamin in analysing them remarks that in essence 'a man and woman who love one another with exclusive devotion are already wedded'.

In the world of spheres naturally we should not expect to find traces of human ceremonial, but we can find there those natural laws which determine the formation of double stars. We can note that in the first place double-stars are generally of equal growth, and in the second that parent suns never unite with their spherical offspring, though such unions are always between relatives of a single system. Hence the ancient usage of marriage between brothers and sisters has its counterpart in the laws of nature.

The early christian church admitted no marriages within the seventh degree of consanguinity, but at the present time the clergy admit marriage under special circumstances within the third. There is little doubt but that, with the increase and evolution of mankind, we shall imitate once more the biblical examples of marriage founded on the natural laws of approximation, inasmuch as the similarity of vital training and custom, and culture are in the closest manner connected with the happiness of conjugal life.

The dependence of civil and social life upon fulfilment of the cosmic requirements of Earth.

If our earth and all the planets demand for their perfect evolution the maximum growth of the human race in health and strength and numbers it is evident that human society, in all its public and private forms, should strive to satisfy this cosmic demand; and from this it follows that every government should place as its first aim the encouragement and improvement of agriculture and horticulture, and have always amongst its leaders men well acquainted with natural history and natural law. Every community is bound to take all possible measures against legislation opposed to nature, however seductive such legislation or social rule might be as an artificial stimulus to mental growth and learning. Everything that is contrary to nature is injurious, and only those actions are moral and noble which are founded on the laws of nature and do not violate the rights of others. Human morality can only stand upon this firm basis. If book-learning demands a denial of rights belonging to the young so far as it does this it is immoral and inadmissable. I think that for this reason all educational colleges should so arrange their curriculum that their pupils could complete the course between the ages of 16 and 18, whilst the universities and technical institutes should be so conducted as not to interfere with the social and family life of the students, certainly without any violation of the general law of the state touching the sanctity of personal rights.

The history of ancient and modern states is the surest proof of what form is best for earthly kingdoms. Looking back at the early world we see what remains to us of its numerous nationalities and civilizations. We see that from these only Egypt, China and India have remained, and we ask ourselves — why have these not also disappeared?

The answer to this question is that these states were and are to the present day exclusively agricultural. Egypt furnishes perhaps the most striking example. By its very conditions this is a state which can only devote itself to the culture of the land. Inundated every year by the rising Nile its southern uplands are covered with rich deposits and grow incomparable crops. Other occupations may serve as helps but farming must always be the secret of its wealth and welfare. Even from the Bible we know that wherever and whenever crops may fail Egypt is an inexhaustible resource, and it is this natural richness of its soil which from the dawn of history attracts the envy and avarice of less favoured countries: it is this which accounts for those invasions which Egypt has undergone. And what came of these invasions after all? The conquerors have vanished from the scene but the country has remained itself, and the same fellahs who laboured under Pharaoh labour now, invincible not from might in war nor from power of mind, but thanks to simple devotion to their mother earth.

In the Indian and Chinese states we see the same. Agriculture is the source of their prosperity and their wealth.

Glance from these to the titanic shadows of the grand military empires of the past. Where is their substance? Whilst her gardens bloomed Persia was great. but when she turned from the culture of plants to the slaughter of men, when in a word she became a military empire, she withered and vanished away. While Rome too, was the owner of her own land her might was solid and unshakeable, but later on — *latifundix pardidere Italiam!* The

land passed into the hands of magnates; patriotism was weakened and destroyed in the heart of the people; morality was ruined upon the lust of spoil and the love of war, so that at last this mightiest empire in the world was ruined, and perished finally. There was a time when ancient Greece reigned over the Balkan Peninsula and dominated the Mediterranean sea. But easy conquests attracted many slaves, into whose hands the work of agriculture passed. The citizens of Greece gave themselves up to art and sport, and Greece fell a victim to their error, for the alien slave could feel no love for alien ground, and the Hellenes themselves, shirking all work upon the land, grew to become like foreigners upon their native soil.

And thus those historical data which I have produced confirm the idea that only agricultural states are durable. From this point of view the future of Russia is more hopeful than that of any other of the European countries, for the land contains all those natural conditions which bind inhabitants to a soil, and compel them to devote their energies to its culture. In Germany though the necessity of agriculture is duly appreciated, the small area of that country and the abnormal development of the towns and manufacturing centres prevents the natural supremary of the land from asserting itself in the lives of the people, and I assume that in the near future in the face of the military aggressiveness of the modern Germans the time for the extinction of Germany is drawing nigh, as such outbursts of militarism are always the beginning of the end.

One cannot but see however that German politics are visibly changing in a more healthful direction. The latest events of the Russo-Japanese war show us that Germany has made a great step towards the peaceful conquest of her neighbours on the ground of economical development of her own people. Standing beyond all competition in the matter of technical production she is at the same time forming settlements on the most fertile

parts of S. W. Russia, maintaining all the while the bond between these settlers and the fatherland. Conquest of this sort is the most effectual form of conquest, as Russia has proved by experience in Central Asia. The Russian conquests in this region are firmly established not by force of arms but by the manner in which the moozhik has established himself there as though at home, finding some little corner for himself here and there and building in such spot his house. This civil conquest is far more lasting than any fruits of military invasion can hope to prove. The myrmidons of the army after their work is done return whence they came, but the emigrant settlers remain; the peasant family strikes its roots into new soil and grows there like a rooted tree, shadowing and defending the land.

We can say much the same of Germans in Turkey, where the enterprising Teuton has not only occupied lands but has possessed himself of the roads leading to the Indian Ocean and the Persian Gulf. It is already quite evident in the apparently approaching division of the Turkish Empire the lion's share must fall to this pioneer race.

According to one authority even in Japan the American system of education is being supplanted by the German, so high stands the reputation of this country as a technical centre and civilizing force. Such a remarkable and hopeful change in the national drift can only be due to that highly educated and intellectual monarch William II, and to all the active scientific committees established under his wise and far-seeing patronage.

Having now looked at the historical aspect of existent and already perished states, and having considered this view of their life in connection with the natural claims of our mother earth, I pass to the question of the future evolution and culture of the human race.

And I would say that at the root of all scholastic learning must lie, beside the knowledge of the child's

native tongue, an acquaintance with the natural sciences and agriculture, for these are subjects which lead us into the solar kingdom and will teach us what are its demands. Without the sun neither we nor any of earth's natural products could continue to exist, and natural science is therefore the very key to our whole life. Secondly physics, chemistry and mathematics as three auxiliaries should be employed, the first to enable the student to recognize the fixed and everlasting principles of nature; the second to help him to understand the essence of cosmic matter, as also how and what conditions that matter is moulded and modified; the third as a practical means of reckoning without which no one branch of human affairs could with any convenience be carried on.

After these things follow geography and knowledge of modern languages and modern peoples. Geography is a science which makes us feel at home all over the earth and language is the universal, enriching and cultivating medium for the exchange of thought.

Knowledge of history plays a passive role in education, teaching rather what not to do; and is of course quite powerless to point the road of progress to any nation, progress being too largely the result of accident and at the mercy of unforeseen events. It is impossible to foretell what cosmic life has in store for any race.

As to the classical languages, to make these the object of study is in effect to turn cemeteries into schools, and epitaphs into text-books of learning. It is as though we disentombed the corpses of the dead and by the bones and fragments tried to judge whether these bodies when alive were beautiful or not, healthy or sickly, how old they were when death mowed them down, and all about them.

Divinity is a psychical science. It reconciles our earthly life and the common faiths of the human beings around us, and therefore it is not at all strange that many nations recognizing as the Creator, one God never-

theless differ widely in their religious creeds and dogmas. Were it possible to subject to examination the psychic condition of any nation at the given time when its national religion took a concrete form we should see clearly why just such a faith should spring to life at just such a time and amongst just such a people.

As an excellent exposition of the causes why the Christian religion spread so rapidly over the earth I must commend a work from the pen of an English author, Mark Wallace. This book contains many strange anecdotes of the personal life of Christ which in some cases seem to conflict with the apostolic records, but which, on deeper study, introduce the reader to the teaching of the christian gospel as the only evangel which could possibly reconcile contemporary mankind to life on earth.

The elements of the christian doctrines had long before appeared in the classic ages. Socrates and Aeschines had reached the dogmas of christianity by philosophic contemplation, but their philosophy withered and died in the rank soil of satiety and were the heritage of only an elect few. A very different picture is presented us by Wallace in his description of the age in which the Saviour was born. This was an age of Roman dominion when all the world lay beneath the iron heel of the conqueror. Outrage and violence were rampant everywhere. Every holy thing, family and life and honour, all was trodden under foot by arbitrary satraps of the central power against whom no complaints were heard and no resistance to whose will offered the slightest chances of success.

By the laws of that age the only witness whose evidence against any Roman citizen in a court was valid was some other Roman citizen. If even a whole conquered province gave evidence unanimously against their governor to the Senate, however atrocious the case might be the Roman Senate was sure always to take the side of the governor and not the aliens, inasmuch as no

one of the latter possessed the privilege to plead. The vanquished were fain to suffer in silence, for every attempt at agitation was suppressed at once by military force; those guilty in such movements were chained and sent to the galleys, their property being confiscated by the treasury and their wives and children sold into slavery. The wealthy magnate of to-day might become to-morrow but a chattel and a slave. Humanity outside the limits of Roman citizenship was degraded; the peoples suffered martyrdom under the victor's iron hand, and the future seemed to the oppressed without the glimmer of a single hope.

And it was in this tragic age that the Saviour appeared on earth with his divine gospel.

You are anxious for temporary blessing, he declared, but you forget the Eternity beyond the grave: you think of your passing happiness here and pay no heed to your everlasting happiness hereafter. You are harassed and affronted and oppressed; but what of that? Your reward in heaven above will be the greater. If any-one strike you on the right cheek offer him the left. All that you see and suffer here passes swiftly away; but in heaven all is eternal.

Such a doctrine could not but attract and pacify all the oppressed and desolate; it reconciled the spiritual side of man to human suffering on earth and it specially drew to itself the poor and unprotected. Hundreds of thousands of such rallied to the Christian standard and bore the tenets of their faith to the furthest borders of the Roman Empire. Faith in God and in Christ became common everywhere, but the dogma and the ritual of this general faith evolved differently under different local influences and conditions.

We must understand that neither the Bible nor Christ were ever opposed to the natural propagation of the human race. It is in the Bible that we find the phrase 'Increase and multiply and replenish the earth', whilst we cannot find there any obstacle to this, or any artifi-

cial barrier set up; and where the Christian records speak in favour of the unmarried life it is in view of ideal holiness and not at all in view of the sort of life led by the bachelors of modern times.

The system of ancient education, though more philosophical than technical, was early completed. Our Divine Teacher conducted a dispute in the Temple with the scribes and Pharisees when he was only fourteen years old, from which it would certainly seem that the education of those times was finished about that age, and it would be an excellent thing if our pedagogues would reduce their programme for the Middle Schools so that the course should end before that period at which a youth attains sexual maturity.

Properly speaking the fundamental principles of each separate science are not extremely complex and are comparatively few, but pedagogues have invented in their own interest a mass of unnecessary artificial problems and difficulties with the design of strengthening their pupils' brains and developing their mental faculties which are far from answering any real purpose in life. Take for example our Russian letters 'yahti', 'yah', 'shchah', 'you', 'pheetah' and êzhitsah'. It is not long since Professor Blagovyeshchenski supplied to one of the Russian papers an article fully explaining the deficiencies of the Russian alphabet. So clear and convincing was his exposition that once having read it one would have supposed that for the scholastic world and for the public press alike there could remain no other course but to surrender to that which common-sense itself demands. Nevertheless neither press nor pedagogues have stirred; and no public expression of opinion has appeared about this needed change up to the present time.

In touching upon questions of scholastic education I am far from wishing to lay down the law as to this or that particular point; my desire is only to insist upon the main fact that the education of the young is a pro-

cess which we must try to simplify and shorten, but by no means render unnecessarily toilsome and complicated.

From the man with ten talents, ten talents must be required. If some teachers in subservience to the red-tape principles of the official world are afraid of the responsibility attached to the propagation of new ideas at anyrate the press has nothing to be frightened of; it may incur the reproach of being liberal or retrograde or prejudiced, but cannot be accused of ignorance for its attempts to lighten the linguistic toils of youth.

Science must employ all means to open the secret treasures of nature to boys while they are young, in order that the pupil on attaining manhood may be in a position to apply his knowledge and to adapt his labours to the needs of our mother earth, for this is a real responsibility which, try how he may, he can not escape.

If the aim of nature in forming man is that he might comprehend and fulfil her laws, and extend the knowledge of them all around, then nations as unions of human beings must not admit either actively or passively that the lives of individuals 'should be destroyed by such an agency as war. Every government is bound to struggle with all its might against epidemics and infectious diseases of every kind, is bound to prevent famine with all its evil train of consequences, is bound to care for the incapable and sick and powerless and most specially for the young. At the same time it must offer no encouragement to idling or those dissipations which breed diseases.

The first thing which governments and states should lay to heart is, as I said, the education of the children especially of the waifs and strays No government, as a body representing a social alliance of people has a right to deny education to the young, whose parents themselves are unable to supply that need. At the first glance the orphan appears a natural bulwark of that government which feeds and educates him. Without

claims or hindrances this creature can be trained in the spirit of the times and impregnated with the ideas which the state recognises as the truth; from a mere waif he can be made a patriotic citizen and useful son of his fatherland. But in fact we observe exactly the reverse of all this. The charity child is bundled about hither and thither, fed by any wet-nurse, nourished on the milk of any cow, given over to the keeping of some half savage family where his diet is chiefly of unwholesome fruits, and, unless his health is exceptionally strong, driven into a premature grave. Those who survive the early test grow up without the knowledge of a mother's love bestowed upon themselves but able to observe it lavished upon others round; they become hardened and sometimes malicious, and instead of good men and devoted patriots too often we see as the result human monstrosities. Even where charity refuges exist many waifs perish in extreme youth, but where there are no refuges there are still orphans and homeless mites needing such aid, and in these places there are many baby-farms and factories for production of angels; there are beggars ready to cripple the defenceless children in the interests of their begging trade; there are thieves and scoundrels seeking free apprentices; in a word every agency is at hand to mould from this raw material some vile shape, but seemingly none to make out of it a man.

We have in Russia only a few orphan refuges and these can be found only in the large towns, whilst on the other hand alms-houses are abundant, to be seen in small district towns and even in many villages.

When we examine into the history of these alms-houses we find that they have been nearly all established on the money furnished by wealthy donors, chiefly of the merchant class. Some famous trader dies, leaving in legacies hundreds of thousands or often millions, and on his death-bed, experiencing some natural pangs of conscience for his sins, he pays a toll to charity for his own soul's good. Having heard many times from

his spiritual pastors that the prayers of others often save the sinner, and considering that none are such pleaders at the throne of Grace as the aged, he builds for such intercessors a warm retreat, in the hope that out of gratitude the inmates of the home will pray for him.

What a mistake! Having been connected myself officially with local institutions of this kind for seventeen years, during ten of which I have presided over one, I have had abundant opportunity and occasion to observe their inner working. I have been able to convince myself by experience that inside the walls of such homes instead of improving spiritual exercises, prayers of repentance and entreaty on behalf of the charitable benefactor, the old paupers occupy their time almost exclusively in scolding and gossip and quarrels merging not infrequently into fights. The causes of all this internal discord are in almost all cases ludicrously trivial — some tool or a needle, or a bit of sugar, or a pinch of tea, or an old candle-end, or some other trifle about which no-one in ordinary life would care to waste a word but which in these places serve as the cause of endless discussions. Why is this?

The reason is simple. The inmates of these almshouses feeling themselves idlers without any occupation, and having all their time hanging heavy on their hands, naturally lose their temper, and those quarrels which ensue not only furnish the principal parties concerned with a temporary interest in life but provide a subject for general disputation and party strife to all their comrades. This relieves an otherwise intolerable monotony.

Meanwhile the remedy for all this mischief is at hand. Only unite these refuges for the aged poor with orphanages and another character is at once imparted to the charity. Of course not all the inmates of the former establishments are fitted to play the part of nurse; there is always about 20 % of infirm and invalids. These again, should be placed apart in hospitals and waited on by those with stronger health to whom for such services

a small salary should be paid. A whole staff of sympathetic nurses could thus be formed. To such a reformed institution farms could be added and public patronage solicited. I am assured that a movement of this kind would grow and flourish like a tree planted in fruitful soil!

In our town society also there are multitudes of young girls in families who, like the class of which I have just spoken, suffer terribly from lack of all occupation. Such should be summoned to the work, for what is more natural to woman-kind than the office of nurse and the love of children. I am certain that once summoned many would answer to the call, and a most useful corps of workers could be formed. The work required from such volunteers would consist chiefly of organization and supervision. If in any town there should be no good souls ready to undertake this labour of love without reward a few experienced women could be invited on a salary, the funds of such charities being fully equal to such a demand. In some alms-houses the keep of each inmate runs to pounds in a month, and the margin here is very ample.

And to the rich upon their death-beds I would say: Leave no money for refuges unless these refuges are united with orphanages; and if the latter class of charity seems to you mere profligate waste — an opinion I have sometimes heard expressed by the provincial Crœsus — leave your bequest in the form of capital the interest on which is to be paid to this or that old pensioner whom the district or town council recognizes worthy of the aid. By this two good ends will be attained; you will aid the family of this sufferer and will enable him to go on living amongst his own relations who will respect the old age which no longer lies upon them like a weight. This indeed will be the best and most useful way to quiet your christian conscience.

Speaking of the aged and infirm I have digressed from the question now before us, the education of the

young. The old man has already outlived his generation; his time is up; but the youngster has the long road of life before him, and none but society to sustain and direct him. Society in its own interests is bound to make out of this young creature a useful member, or it punishes itself. The preservation and guidance of these young lives is not only a moral duty it is a natural charge which every citizen must lay to heart, though even from the point of view of christian service there is more to be said for aid extended to the young than to the aged. How constantly the memory of the adult dwells upon the years of former childhood and how it sanctifies with an oreole the heads of those who in those early days showed kindness to their youth! how readily one blesses the thought of those now distant acts which have since born good fruit in one's own life!

The next question relating to aid for the helpless concerns famine and hunger.

In civilized states there should be no possibility of death from starvation as every one of the citizens possesses a primary right to the means of subsistence and the preservation of his life. I eat and drink not as a personal caprice but in answer to the call of nature, which herself has supplied to hand the means of compliance, and if it happens that there is a lack of such means government must come to the help of the needy, for it is only in the multitude of healthy citizens that any state has a reason to rejoice. A consciousness of this primary duty is growing stronger amongst civilized nations, and I apprehend that work-houses will play an important role in the future of social economy and co-operation. If we now see not infrequently men of the educated classes without any means of subsistence, the spectacle of utter need amongst the peasant class is still more terrible. For the unhappy peasant famine is such a frightful scourge that he flies from it to the towns where naturally he fares not better but even worse than our more cultured starvelings.

To produce effectual results work-houses must be established not only in all towns but in all peasant centres, The labour offered must be simple such as lies in the power of a simple countryman; and to support these public labours the government would have a right to the monopoly of articles of universal use — such for instance as matches. The simpler stages of the preparation of the match might very suitably be made a government monopoly upon this ground, whilst the final processes of manufacture requiring greater skill remained in private hands. And there are many other industries which in accordance with local requirements could be thus monopolized.

It is esssential that beggary, as a social phenomenon offensive and degrading to human self-respest, a product, of drunkennes and deception, sooner or later should be abolished, and as behind beggary are concealed the pressing needs of existence, it is even immoral to leave the unfortunate in hopeless want. Life must be so arranged and organized that no man should for a moment be in doubt about his daily bread, but that every man should rest assured that he and his family will receive infallibly what wholesome food they absolutely need.

Thus in a few chief points I have indicated the demands upon us human creatures of our planet earth. Man we have seen is earth's latest creature, earth's right hand; but man, himself, does not remain unchanged. As earth develops so do we. On examining the fossilized kingdoms of the prehistoric age we see that the antediluvians were a bony race; we notice that the epic age supplied a muscular race; contemporary humanity is entering upon a nervous epoch; and the future will pass into an age of brain and intellect when, it may be in the course of thousands of years, men will present an enormous head and miniature members. But this man of the coming age will be nature's king, who by the waving of his wand can bring into play nature's giant forces, the owner of the magic ring and possessor of the magic

lamp. Perhaps if he desire it, he will be able to breakfast in Europe, dine in Asia, sup in Africa and pass the night in America. Who knows? As Derzhavin says: "I am a king; I am a worm; I am a God?"

So, having passed in review the claims of earth on man and the aspects of human life in that connection, I pass finally to the essential nature of that earth itself. That earth, I say once more, is a living organism, and as a cosmic being must share the luminous qualities of stars. If all the stars we see and even perishing systems in the form of cosmic clouds have their own light, so has our planet earth. Though we can find no means to analyse that light we can infer from plain analogy what it must be. Its spectrum beyond doubt is the planetary spectrum since we can see within our atmosphere the universal and uninterrupted flow of oxo-hydrogen upwards and outwards into the space ruled over by our sun.

Conclusion.

Having analysed cosmic phenomena, the laws of origin, and the application of these phenomena and these laws to human life, it is easy to convince oneself that however rational and intellectual man may be, however free his will may seem, he is in fact powerless to move beyond the limits assigned him by the nature and the needs of the earth he lives on, and that any attempt to transgress these limits can only threaten the offender with the penalties of ruin and of death. Human morality is therefore seen to be grounded on the laws of nature herself, not upon any inventions of human ingenuity.

Life is an eternal forward movement founded upon the propagation of species and development, so far as our earth is concerned, of terrestrial culture. All that aids this process of culture, in whatever form, is moral; all that hinders and opposes it is immorality itself. It is easy to see what we must require from our religion, our laws, our social institutions and our family life. In all these departments alike our morality must root itself in the claims of nature and express itself in actions and in thoughts conformable to natural law and not transgressing against the rights of others.

This latter element in morality corresponds in a somewhat modified form to the commandments of our Saviour: Love thy neighbour as thyself and Do unto others as thou wouldst they should do unto thee, and indeed

this commandment lies at the root of all civil and social life. It is the unchanging basis and bed-rock of human society; all our civil and political and social prosperity, all the future of our communal and family life, nay even the cosmic future of humanity at large, can rest on no other foundation.

Errata.

Page	a line	for	read
1	5	significence	= significance
1	10	kuow no	= know no sound
2	36	irrecomileable	= irreconcileable
3	2	as	= a
7	31	bagan	= began
9	7	revolving in	= revolving on
10	27	.... so geographical miles	= ... 20 g..... m.....
11	4	aquired	= acquired
„	11	Tomson	= Thomson
„	„	Farbes	= Forbes
„	28	ouly 300	= only 3000
12	18	eigths	= eighths
13	4	doult	= doubt
„	12	Egyptain	= Egyptian
„	19	passessing	= possessing
15	2	men	= man
„	19	circumferance	= circumference
16	2	direction opposite to that of the	= direction of the
„	21	hy	= by
18	16	electic	= eclectic
23	22	these are parts	= there are parts
24	12	degress	= degrees
25	3	bood-vessels	= blood-vessels
27	2	a	= A.
39	14	posses	= possess
42	31	untoubted	= undoubted
44	27	swin	= swim
„	35	morc	= more
46	28	consumptions	= consumption
49	15	amonnt	= amount
51	38	observattons	= observations
57	36	event	= even
59	21	HO_2	= Noe
60	25	burched	= bunched
63	9	ihe	= the
64	24	it"	= is
68	13	tover	= over
„	24	shoald	= should
71	19	thoug	= though
73	4	of gases	= ints glawing gases
77	16	yellou	= yellow
78	13	atmospherial	= atmospherical
79	12	planet	= comet
„	31	8 moons	= 9 moons
80	29	see inn	= seen in

Page	a line	for		read
82	8	their thoughts and desires	=	their desires
84	16	abready	=	already
„	26	docs	=	does
85	38	atmospherie	=	atmospheric
86	6	to volcanic energy	=	to its volcanic energy
87	23	con	=	can
90	31	glohes	=	globes
91	13	scence	=	scene
92	2	corps	=	crops
93	3	where necessary	=	were necessary
„	5	fare more	=	far more
94	17	entircty	=	entirety
95	11	nourishmen	=	nourishment
96	35	conjuction	=	conjunction
96	36	envelope of hydrogen	=	envelope of nitrogen
97	4	carbon	=	anhydrous carbonic acid
103	13	trifting	=	trifling
104	28	a characteristic feature double stars	=	a characteristic feature of double stars
105	20	posses	=	possess
„	32 u 37	Pointclaret and Pourn-claret	=	Pointcaret
106	9	cas	=	case
108	6	in fully	=	is fully
109	7	in still further	=	is still further
110	4	converted	=	converted into
111	1	longitude	=	latitude
117	38	cosmis	=	cosmic
118	9	hat	=	that
119	26	signifiance	=	significance
124	2	through	=	though
127	1	conesquence	=	consequence
„	2	ighter	=	lighter
„	11	wate	=	water
„	12	distiller	=	distilled
132	33	i. c.	=	i. e.
136	37	ower	=	over
145	21	and as is this...	=	and as this...
146	33	dicharge	=	discharge
147	3	minutcs	=	minutes
149	1	streamo	=	streams
„	19	exists	=	exist
152	1	amphibions	=	amphibious
153	20	andoubtedly	=	undoubtedly
161	38	seents	=	scents
162	26	anothere	=	another
„	26	agreable	=	agreeable
167	38	care	=	case
171	11	next-door the criminal	=	next door to criminal
174	23	encues	=	ensues
175	17	wich	=	which
180	3	morality was ruined	=	morality was wrecked
„	25	supremary	=	supremacy
182	11	and what conditions	=	and under what conditions

½ dollar, 3 fr., 1 rbl.