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# COSMOGRAPHY;

OR,

## PHILOSOPHICAL VIEWS

OF THE

## UNIVERSE.

BY

CHARLES F. WINSLOW, M.D.

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“The heavens are thine; the earth also is thine: as for the world and the fulness thereof, thou hast founded them. The north and the south, thou hast created them.—PSALM lxxxix. 11, 12.

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P R E F A C E .

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IN presenting this little book to the world, I did not intend to make any prefatory remarks, inasmuch as I had expressed a word here and there in its pages by way of apology for what may be considered innovation or presumption. But, since the work has passed the press, I have felt more than ever the necessity of great accuracy in the pursuit of its important inquiries ; and, though my convictions of the correctness of its main features are continually strengthened, I would have my ideas expressed with such precision, that there should appear nothing like error in the facts stated, or in the philosophy set forth. In some instances, this

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object may not have been fully carried out; and I feel sensible of several deficiencies which will probably be observed by others.

The composition was first commenced as a private letter, by way of amusement, to a scientific friend; but, the subject having enlarged itself beyond my intention, I followed the suggestion of others, and changed my purpose so far as to transform the epistle into a book. Since doing so, I have partly regretted it, for reasons stated sufficiently at large in the body of the work. The views, however, if altogether erroneous, will do no harm to mankind; but, if correct, they will enlarge the bounds of human knowledge, and impart fresh vigor to scientific inquiry.

March, 1853.

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PART I.

DEVELOPMENT OF THE THEORY OF REPULSION AS  
A PLANETARY, SOLAR, AND UNIVER-  
SAL FORCE.



## P A R T I.

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As comparative anatomists, by careful observation of a fossil bone or tooth, may reconstruct an animal or race which lived during some incalculably remote epoch; so, by the study of a planet or comet,—mere fragments of the cosmical system,—the primordial condition of the material universe may be discovered, and the action of the laws traced, which governed the creation and motion of the celestial spheres. To attempt merely the outline of such an object is a work of great labor; but contemplations which have given the writer much enjoyment may, when expressed in

methodical form, be pleasing and profitable to the general reader, and not without importance to philosophers and scientific inquirers.

When observing any animal form, we notice its symmetry; but we know nothing of its internal composition, or the principles of its organization, until we have exposed its entire structure, not only to general, but to microscopical examination. Then alone we discover the facts on which we can found the laws of its inception, growth, and complete creation. The first motion of its molecules, tending to its inception, we may fail to discover, because that lies beyond material being, and is the creative principle itself, lying so remote as to be hidden in chaos, but still so near as to teach that it is the direct agent of the thought and will of God. I shall apply this illustration, so clear and natural as it is, to the principle of analysis which I shall

pursue hereafter, in attempting to unfold the mysteries of cosmical creations. To arrive back at the ultimate cause of all things, is what I do not expect nor attempt; but only to examine the sidereal universe, in connection with its great organic forces; to trace matter from its present combinations to its original conditions; and to endeavor to expose the fundamental principles which presided over its agglomeration, and its creation into the actual, visible forms presented in our contemplations of the universe.

In nature we behold matter existing under two distinct and remarkable forms: one is the condition of separate individual molecules; the other is the union of these molecules in such prodigious numbers as to constitute the rotund, cosmical spheres suspended in infinite space. Isolate a molecule in the imagination, if possible, and we find it possessed of two principles

which govern its relations to all other molecules : these are attraction and repulsion. Philosophers differ somewhat in opinion about the exertion of these forces, when molecules are brought into close relation with each other. One, for instance, imagines them separated by an imponderable, inappreciable ether, which, like the atoms themselves, expands and contracts, and which prevents them from ever coming into direct contact. Another believes that molecules are brought by attraction within definite distances of each other, and that there repulsion acts to prevent a nearer approach. Apply external force, and overcome this repulsion beyond a certain degree, they approach nearer, and unite with each other into closer relations, forming chemical compounds. These theories are more or less ingenious or probable ; but, as the explanations of the relations of molecules are doctrines developed by pure

reason, acting on certain known facts, the highest orders of intellect may not entertain exactly identical views; and it matters not particularly to the final result of this inquiry, as all are agreed on the existence of the two properties which attach to the ultimate particles of matter,—*attraction* and *repulsion*. Bring one atom gradually toward another atom; and, at a certain point, they attract each other, and approach nearer, through the agency of a power residing within themselves. At a certain distance, before they come in contact, the force of attraction is arrested; and they are kept apart by a power of repulsion, which, equally with that of attraction, resides within each molecule. It is an admitted fact in philosophy, that these properties do attach to all ultimate particles of matter. It is a difficult thing to imagine the combination of these imponderable, polarizing essences or forces with the

atom of material substance. So far as I can trace these forces to their first action, it has seemed to me necessary, for the purpose of establishing motion in the primordial molecules diffused throughout space, for them to have these forces located respectively in foci equidistant from a given axis. The principles of attraction and repulsion being opposite, and thus located, the molecule would be polarized; and the consequence would be, that, in attracting and being attracted, repelling and being repelled, for the purpose of attaching themselves to each other, a rotary movement would be imparted to all, and the fundamental act of celestial motion would have been established. Admitting this constitution of individual molecules, the same action of rotation on their axes might be imparted to all spherical agglomerations, however vast their magnitude.

However molecules may be endowed by

these opposite forces, we can only determine their mutual action and reaction with distinctness when they are aggregated into spheres, by the observation of comets, when moving within the visible influence of the great central body.

The sun is supposed to exert its attractive force on its revolving spheres, direct from its centre. Physical astronomers, in all mathematical computations on the distances, motions, &c. of the heavenly bodies, make their calculations from the centre of the sun. Comets are translucent bodies; and, by that remarkable property in their physical constitution, they exhibit, with great beauty and distinctness, the mobility of their molecules; and we can see them condense towards the centre, as these bodies approach the sun, until they have formed a nucleus, so bright, in some cases, that they are almost star-like. If there be any reciprocity of central forces between

the sun and its revolving spheres, we can certainly form some idea of their action, from the physical changes which we observe to take place in comets, as they approach and recede from the sun. This is certain, as they approach the sun, their circumference becomes more defined and disk-like, and their centre more dense and compact. The sun, exerting its power from its centre, draws them along their orbit. Is this concentric accumulation of molecules the result of an attractive force in their centres, acting reciprocally with the increasing power of the sun, and assisting them in their gravitating course toward the central body? or is it the result of a repulsive force, exerted from the circumference of the comet towards its centre, by which its disk becomes more defined, and the whole cometary mass more compact, and by which it is prevented from falling into the sun? or are

these extraordinary appearances the results of the combined action of the two forces of attraction and repulsion, made visible by the translucency of comets? Whatever the nature of the solar forces, or however the central forces of the revolving bodies may respond to the solar forces, one thing is certain, the more the molecules of any mass of matter are compressed by external force, the denser that mass becomes, and the greater is the degree of repulsion awakened between its constituent particles. On a mass of matter, possessed of great molecular mobility, which we may hold in the hand, we may see the effects of mechanical compression. The mass becomes smaller, and the particles composing it are contracted into a narrower compass. They are forced into a smaller space by the repelling power of external pressure. When this external pressure, which acts like repulsion on the outer layer of molecules, is

removed, the whole mass expands from centre to circumference, and regains the volume it possessed during the natural equilibrium of its particles. What do we behold in comets as they approach and recede from the sun? When they approach, they diminish in volume, become more dense in their centre and defined in their spherical form. These phenomena increase till they pass their perihelia, when they begin to expand in volume, become more rare, and less defined in their disk; and these characteristics increase till the comet passes out of sight. The sun's action on the gaseous bodies of comets, is similar to that of mechanical pressure on a small sphere of the same composition. What would be the effect of a like action of external pressure upon a hollow sphere of India-rubber, filled with some dense or viscid liquid? The same as on the gaseous sphere. The particles composing

the ball would be forced into a smaller volume; and, if the pressure was not uniform, various parts of the surface would protrude or crack, and its fluid contents would be poured out upon it. Now, what happens to the revolving spheres, whose crusts are solid, when they approach the sun, and while they are in those parts of their orbits nearest to the central body? The crust is convulsed by the tension of internal re-action; the fluid contents of the interior escape to the surface; and the solid crust of the planets rises and falls, in accordance with the local and violent, or the slow and gradual, action of these central forces. These phenomena are all exhibited in direct proportion to the exertion of the solar forces; and they are observed at their maximum, when the earth is nearest the sun; just as we observe the violent commotion of the molecular elements of the translucent comet, under the same circum-

stances. This interesting subject I shall examine more in detail, in a subsequent part of this treatise.

From these remarks, it would follow that the physical influence exerted by the sun upon revolving spheres, approaching and while nearest to it, is similar to that of mechanical compression. External pressure on an elastic ball in our hand is nothing more nor less than a repulsion imparted by our hand to the external layer of molecules composing the ball; and this external layer communicates its repulsive action to the next; and so the effect of repulsion is produced from the circumference to the centre, and a reflex action ensues from the centre to the circumference. The sun is so vast a sphere, and we are so remote from it, and our means of observation so imperfect, that it is impossible for us to discover any change in its disk or appearance, as its dependent revol-

ing spheres approach and move around it. Of its properties we can judge only by studying effects which proceed from it.

Since the days of Sir Isaac Newton, astronomy has recognized the reign of one principle only among the heavenly bodies for the maintenance of the stability of the universe, — that of attraction. It has become a question of the most profound importance to my mind, whether there be not another, exercising a dominion equally secret and potent; acting in a manner antagonistic to gravitation, and sustaining, not only the harmonious relation of the various members of our solar system to each other, but that of all the suns, and their systems of revolving orbs, throughout immensity. If a second active principle, reigning over the stability of the universe, be admitted, — that of *repulsion*, — it appears to me that some of the most difficult problems of celestial motion may

be easily and beautifully explained. The varying dimensions of the lunar orbit, the lateral expansion of the earth's orbit, the steady advance of the perihelion points of all primaries and secondaries in our system, the precession of the equinoxes, the contracting dimensions of the orbits of certain comets, and the revolutions of multiple stars, are among those prominent phenomena which appear to require the existence of some active principle, antagonistic to that of attraction, to render their explanation completely simple, satisfactory, and conclusive.

In molecules, two antagonistic properties exist; and these molecules, in their multiplied agglomeration, constitute the various revolving spheres, all the way from the smallest meteoric masses to the mightiest central suns in the universe. The principle of attraction follows the agglomeration of these particles of matter; so that, in the

revolving bodies, it is manifested in direct proportion to the mass of matter, and assumes a magnified energy, called planetary or solar attraction. Why, in this agglomeration, should not the same principle of repulsion, which exists in individual molecules in like manner as attraction, be magnified and multiplied into a universal power of repulsion, so as to become a central planetary or solar force? If it be, then all revolving spheres must be possessed of a certain degree of repulsion, which, acting on each other as repulsion acts on molecules, must keep them at fixed distances asunder, and prevent them from coming into contact. In spheres, as in molecules, which are infinitesimal spheres, the attraction would ever exert its action within definite distances, beyond which it would not extend. We see this very principle exerted in the planets over their satellites; and their influence extends not beyond cer-

tain absolute limits. So with the sun. Its attractive power is exerted over all the cosmical bodies within the limits of our system. That is the domain of solar attraction. That force, by which it causes all bodies in our system to gravitate to its centre, loses its influence beyond a certain bound. Then come the boundaries of other stellar empires. Thus the entire universe is partitioned off, and the innumerable multitude of stellar worlds hang on nothing throughout the boundless realms of space. It is only when we contemplate the sun in relation to other stars, that we discover the exhibition of the great force of solar, or rather of stellar, repulsion, by which the whole heavens are maintained in the most wonderful harmony during their vast sidereal revolutions. Admit repulsion to exist as a universal force, manifested by spheres, and acting in harmonious but antagonistic combination with attraction upon all, and

the elements of a compound motion are at once brought into being; which will explain the various forms of planetary and cometary paths, and permit a universal stellar motion, without the necessity of imagining a great central body, to which the outer zones of celestial spheres are gravitating.

In contemplating the vast orbital motions of the heavenly bodies, and tracing the exertion of the forces in the molecules to their multiplied exhibition in the spheres, it has seemed to me that repulsion must act, in all forms of matter, as a reflex power. It is never exerted by one molecule on another, until they are brought within a given distance of each other. The circle of attraction extends beyond the circle of repulsion, insomuch that molecules, when within given limits, are drawn towards each other, with power increasing as the squares of their distances diminish, until they have attained a relation fixed by the

law of repulsion. There they become stationary, and repulsion maintains them at specific distances from each other. Force them beyond this point, and they re-act with visible energy. Attraction is constantly exerting a superior power up to a certain point, and a positive one always at all distances within the circle of its influence; whereas repulsion begins to act with antagonistic energy only at a point within the circle of attraction. Up to that point, repulsion has exerted no energy, and has been a dormant or negative force in the molecule. But at a given point its force is awakened; and then it becomes also a positive power, but antagonistic or reflex in its action. Press the molecules nearer to each other, and this reflex force of repulsion is clearly demonstrated.

If I have clearly and correctly stated these principles respecting their manifestation in molecules, we shall find a similar

exhibition of their magnified action in spheres revolving in space, whose motions are free, and so majestic and vast that the mind is almost bewildered in contemplating them. The Newtonian philosophy and universal scientific observation have established beyond question the great principle lying at the foundation of celestial dynamics, called *attraction of gravitation*. Since the sidereal motion of the universe was discovered, this force has been considered to act, from the uttermost bound of stellar creations, towards some central point in infinite space, capable of controlling the entire mechanism of the heavens. It has been supposed that no other power existed in nature of so gigantic a character, and that no other was necessary to maintain the equilibrium and stability of the universe. It is supposed that gravitation exerts itself in such a manner as to create a mutual dependence of one celestial body or system

upon another for support, by the exercise of its attraction in opposite directions; so that the entire sidereal creation, from its centre to its outmost borders, is bound together in harmonious relations by this force alone. Is this a reasonable supposition? Does it explain satisfactorily the mutual revolutions in equal or unequal, or in eccentric orbits of the double and multiple stars?

As no other principle of universal power has heretofore been suspected to exist in the universe coextensive in its action on the cosmical spheres with gravitation, I shall present the supposition of a force of universal stellar repulsion, and invite the scientific world to demonstrate that it does not exist. I shall present some aspects of the universe, in which it appears very probable that some gigantic, antagonistic, or reflex principle exerts an agency; and physical astronomy must decide the existence

or absence of such a fundamental power. Suppose the suns, with their primaries and secondaries, each forming a stellar circle, to be suddenly created, more remote from the great attractive centre than they are at present. The central body of each solar system—in other words, the sun or star itself—will be the body whose influence will be exerted on the other stars, and which will be attracted to the great central point of the sidereal universe. Suppose all to be attracted to the great centre by the present existing power of gravitation, why would not all fall, one by one, successively upon that point? If moving with the proper sidereal motion, as at present, why would not all be gathered in gradually, and be swallowed up in that centre? If the suns in the outer zones of the universe are attracting all their planets toward their centres, and maintaining them in harmonious relation to each other, still

the suns themselves must yield to the gravitation whose action is to converge all stellar bodies to the great central focus. The suns may exert an attraction upon those next to them, yet all must yield gradually to the irresistible action of the one imperial, celestial law.

Now, on the other hand, suppose the suns suddenly and perfectly formed as before, and more remote than at present from the great sidereal centre. Let each star be endowed with a force of repulsion, to remain negative or dormant within itself, until awakened at a given period. Let it, at the same time, be endowed with the Newtonian principle of gravitation. Now let the universe commence its proper sidereal motion, and the stellar forces begin their action. The stars will begin to fall to the central focus. All their planets will fall with them, as beautifully as the satellites of Saturn move with it in its revo-

lution round the sun. The stars alone sustain these vast and primary relations to the great sidereal centre. Their planets are but secondaries in this case, and exert no influence on other stellar circles, independent of the central solar powers. Now all are converging, with accelerating power, to the sidereal centre. Those which approach it first would fall together, unless the dormant principle of repulsion was awakened in them. What would be the result? They would assume a curvilinear course, to avoid each other, follow the general sidereal motion, move around the central focus, and revolve around each other. Stars more remote, falling next to them, would encounter the same resistance to further approximation to the centre, exert a mutual repulsion, and continue to follow the general sidereal motion. So with all the stars in the universe. Their final distance from each other would de-

pend upon their mass, and the peculiar properties of their material constitution.

In the organic acts by which the stellar bodies were condensed, and made to fall into their present arrangement in space, it is probable that difference of dimensions and physical constitution would create inequalities in the velocity of their motion. This might bring into definite relations bodies framed at immense distances from each other, and they would necessarily form local systems of mutually revolving suns; and, under certain circumstances of approach, their repulsive powers might so act, that, while one became a central and comparatively stationary body, other members of the group might be thrown into retrograde or direct orbits, and move around it. The arrangement of such clusters of stellar systems might be such that their centre of equilibrium would be so near the central star, that to human vision,

however highly aided, it would appear entirely stationary. Telescopic scrutiny is revealing double and multiple stars, to the amount of many thousands, in both hemispheres. The difference in color and periodical variations of luminous intensity of some single, double, and multiple stars, indicate decided differences of physical constitution among the heavenly bodies. Even in our own system, difference in size, density, color, form, and distance of the revolving orbs, indicates radical differences of physical combinations, and modifications of the fundamental powers which in them respectively respond to the great central solar forces.

Now, what would be the effect of this repulsive principle upon the primaries of these suns? The cosmical bodies of our system are so near, that we can contemplate their motions with much certainty of precision and correctness. We see them

fall towards the sun, striving, with accelerated velocity, to reach its centre. In a path as true as the curved form of a conic section, they pursue their course until they can attain a point no nearer the sun than their perihelia. Then they recede, not at a tangent, but in a similar curved line, so as to complete a perfect ellipse; and the time which they occupy in their vast revolutions can be computed to a second, through endless cycles of the past and of the future. Such would always be the case, if no disturbing forces were exerted upon them. The laws governing their motion are so perfect, that their repeated revolutions show the matter in each to have been weighed by the sun so accurately, that a molecule added or taken away would modify the degree of attraction, and change the size of their orbits. Heretofore, it has been supposed that the definite and exact value of these orbits

has been preserved unchangeable by attractions of the heavenly bodies external to them, counterbalancing their gravitation to the sun. It has been supposed that the planets have been thrown off from the sun; and, having received a centrifugal motion from the rotatory force of the sun, they have been restrained by attraction, and brought, by the compound action of these forces, into an elliptical path; and so they revolve for ever around the central body by the power of gravitation alone. These doctrines need to be resurveyed with great candor and care; for, if an element of universal repulsion should be found to govern the relations of the heavenly bodies, it would greatly facilitate the researches of mathematical astronomy, and lead to yet more wonderful discoveries in the physical constitution of the universe.

In contemplating the motions of the planets, we find them moving in orbits

more or less elliptical, and the sun not occupying the centre, but one of the foci of the orbit. This position of the central body in the planetary orbits is necessary for the maintenance of the present relations and economy of the universe. Suppose the earth to be situated at a given distance from the sun, and both at rest. Suppose their mutual forces of attraction and repulsion in perfect equilibrium. There they would remain for ever at rest by their inertia. Now, impart an impulse to the earth. The forces of attraction and repulsion being in equipoise, the earth would move in a perfect circle around the sun. So would all the planets under similar relations; and, under the same circumstance, the secondaries would move in like manner around their respective primaries. But these are not the natural relations of the cosmical bodies; and the forces exerted by them, though capable of acting in equi-

librium, are exerted on bodies to which an impulse had been communicated previously to their coming within the influence of the reflex power of repulsion. We will again suppose our sun and its attendant spheres to be created suddenly and perfectly, but more remote from the great sidereal centre than their present arrangement. The sun would tend, with accelerating velocity, toward the sidereal focus. Its attraction, as a positive force, would be exerted to assist to carry it toward that centre, until it attained a certain point in relation to other suns; and there, attraction would become inoperative, and would be replaced by repulsion, which would be exerted to prevent a nearer approximation of adjacent stars. During the active operation of the sun's attractive principle, the planets would move in the same manner, and press forward towards the solar centre. Solar attraction would increase in

intensity, the reciprocal attraction of the planets would be communicated to their satellites, and all would move with accumulating velocity to their respective central bodies. When the earth, for instance, had attained to that point in space where its repulsive power was awakened, in connection with the repulsive power already exerted by the sun to sustain its proper relation to surrounding stars, it would begin to be arrested; and, following the general sidereal movement, would still endeavor to reach the sun. At last the point of the orbit would be reached when the planet could approach the sun no nearer, and would be at its perihelion. The accumulated velocity which the planet had acquired, during its fall through space to this point, would drive it at a tangent from the sun, but for the power of attraction, which still holds it within a definite distance. It continues to move by

necessity, and hereafter will be acted on by the compound force of the two powers of attraction and repulsion, which are exerted through the sun from the sidereal centre. An equipoised action of the two forces would exist only when the planet moved in a circle around the central body, at uniform radial distances from it. Moving in an ellipse, with the sun in one of its foci, the two powers would be exerted unequally upon the revolving body in every point of its orbit. The power of attraction would be predominant while the planet was approaching the central body, and repulsion while it was receding from it. The regular action of these forces upon all revolving spheres within the circle of their influence would be to bring them within the range of their equilibrium; but, being exerted by the sun to sustain its relations to other stars, these forces are constantly in a positive state of action, alternating

their intensity only as revolving spheres are brought within, or carried beyond, certain points equidistant from the solar centre. Now in these respects the attractive and repulsive motion of the planets, in regard to the sun, resembles the action of molecules when they are forced within or beyond a certain point of relation to each other. This is remarkable ; and when we consider that the entire sidereal universe is composed of cosmical spheres, which are merely vast agglomerations of molecules possessing two positive and known forces of attraction and repulsion, absolute and reciprocal, and that these molecules must carry their individual forces with them under all circumstances, we must think it extraordinary if only one force, that of multiplied or planetary attraction, should exist, and that the universal influence of repulsion should be lost in the agglomeration. If this doctrine is examined by

astronomers and philosophers, and applied to the heavenly bodies in all its details and with mathematical accuracy, I have ventured to believe that it will result in the most beautiful harmony of numbers, and in the simplified demonstration of phenomena which have heretofore been mysterious or inexplicable.

If we extend this investigation one step further, and follow the moon in its revolutions round the earth, we shall observe that the dimensions of its orbit are inversely as the distance of the earth from the sun. When the earth is nearest the sun, its repulsion is the greatest; and then the moon, sensible of the influence of this positive and powerful force, is the most remote from the earth. Being the dependant of the earth, as the earth is of the sun, it is obedient to terrestrial forces as its primary is obedient to solar forces, and as the sun is in like manner obedient to the

great sidereal central forces. So, again, when the earth is most remote from the sun, the moon's orbit is the smallest, and that body is nearest the earth. Here the repulsive force of the earth, superinduced by solar influence, has become greatly diminished; and the moon, obedient to attraction, falls nearer to the earth. Hereby its motion is accelerated, and its orbit diminished in size. Thus these inequalities of the lunar orbit alternate with each other; and the slightest changes are compensated by the opposing forces, in exactly opposite points of the earth's orbit. During the earth's advancement to its perihelion, the attraction of the sun is positive. The earth yields to it with accelerating velocity; and, at the same time, a principle of repulsion is accumulating in it. The moon, being the earth's dependant, feels this as a positive power, and recedes progressively, until, at the perihelion, terres-

trial repulsion is at its maximum: there the lunar orbit is greatest. The intensities of the terrestrial and solar forces are here exchanged. The sun's repulsion becomes positive, and the repulsive power of the earth is gradually yielded up. Attraction becomes predominant and positive, and the moon falls again towards the centre of the earth. Such appears to be the action of these forces. Both undoubtedly exist; but a complete understanding of the complex details of their action I do not pretend to possess. Future investigation must establish the accurate operation and adjustment of these forces. The translucency of comets exhibits, with unmistakable distinctness, the remarkable fact, that alternating changes of molecular arrangement do take place throughout the entire radial structure of cosmical spheres, through the action of these all-pervading solar powers. The body approaches the sun, and we

behold its volume diminish, and its particles condense, towards its centre. The condensation of these particles indicates the exertion of a force upon the atomic constitution of the comet which acts similar to external pressure; and, as a natural result, these molecules must exert a strong individual repulsion upon each other. The whole comet, then, at its perihelion, through the individual action of its molecules, would be in a high and positive state of tension and repulsion. The consequence would appear to follow, that this body, by its original momentum, added to the velocity acquired in falling through one half of its orbit, had been impelled into solar relations unnatural to the equilibrium condition of its molecules, and thereby a force of repulsion had been awakened in them, which reached its maximum when the body was at perihelion; and that this repulsion, added to its accumulated velo-

city at that point, must be the force to project it through the receding half of its orbit. The same action must necessarily be exerted on all other revolving spheres; but their density and physical constitution are such that no telescopic observations have as yet discovered any change in their form or appearance. Inequalities in the lunar orbit, however, show an exhibition of similar forces excited in the molecular structure of our own planet; and geognostic phenomena, which I shall examine hereafter, will confirm the existence of the positive and alternating operation of these radial forces, and of a powerful internal tension exerted from the centre to the surface of the globe.

Of the existence of these antagonistic powers of nature, their compound action, and their alternating intensities exerted to maintain all the celestial motions and the stability of the universe, I cannot doubt;

but the methods of their operation are complex and mysterious. Still, the exercise of these two powers in spheres should excite no more surprise than their exercise in molecules. We can demonstrate their existence in either case only by their effects; and, if a power of attraction, multiplied in proportion to the accumulation of molecules, should be manifested, and the opposite principle of repulsion — which, in the isolated molecule, accompanied attraction side by side — should be lost, or become negative, we should wonder more at the method of its extinction than at the effects of its exhibition. The operation of these mysterious principles on matter, or their connection with matter, mankind perhaps may never fully comprehend. The exertion of these great forces of nature, growing out of their connection with matter, is no more wonderful than the manifestation of the varied powers of the

human understanding, and no more difficult of explanation than the connection of these powers with the organized fibres of the cerebrum. Both lie deep in the constitution of nature, and both equally display the most consummate wisdom and marvellous power of the Deity.

Inquiry, however, is always legitimate, when based on facts; and the accumulations of scientific research would allow, at present, some attempt at generalization.

I have heretofore stated, that, as far as my contemplations could trace the indwellings of the two powers of attraction and repulsion in molecules, they resided respectively in foci equidistant from a given axis. What would be the mutual action of molecules thus endowed, at equal distances from their axes, with opposite principles? This is neither more nor less than the polarization of matter in its ultimate state of divisibility. We shall conceive

at once,—if in boundless space, where these atoms of matter could move with the utmost freedom, — that, if points endowed with similar principles were presented to each other, motion would ensue. Suppose the universe of matter, in its primordial, attenuated, and molecular state, to be suddenly endowed by the Almighty with these two forces;—being on each side of the given axis of a molecule, universal rotary motion would be imparted throughout infinite space, nuclei would be established, and matter would agglomerate into spherical forms.

Whatever the special act of the Creator was, by which central points or foci in various parts of the universe were located, the uniform result would follow, that atoms would carry into their agglomeration the fundamental forces and properties which they possessed in their original isolated condition. Thus their powers of

repulsion and attraction would be multiplied in proportion to the accumulation of molecules, and the effect of their union might be even to intensify the forces aggregated in the mass. Now, present two spheres to each other, thus formed and thus endowed. Both are polarized, and endowed with opposite principles, in every particle of their structure. They had received a rotatory motion during their formation ; and it must continue by a physical necessity, and depend upon reciprocal antagonism of forces established in the dawn of their being. Here lies the secret of rotation in the heavenly bodies ; for it is quite clear to the understanding, as they hang in space, suspended only by the forces of attraction and repulsion, that they must always move in such a manner as to maintain the equilibrium of forces exerted between themselves and the bodies on which they are dependent for support. Thus in

our satellite we behold these forces adjusted to some special manifestation of force in the primary, and so acting that the same meridional areas of the moon are always presented to the earth.

This demonstrates clearly that some polarizing principle is accumulated on the terrestrial side of the lunar axis, which responds to an attractive influence pervading the entire mass of our own planet. A similar correspondence of phenomena is observed to exist between Jupiter and its satellites; and, so far as observation extends, the same unique relations are believed to hold between the planet Saturn and its numerous dependencies.

All these inquiries are very curious, and the phenomena so remarkable that science will be richly rewarded by diligent explorations of these mysterious paths through the celestial universe.

PART II.

ANALYTICAL EXAMINATION OF THE SOLAR SYSTEM,  
AND APPLICATION OF THE THEORY OF  
REPULSION TO THE CREATION  
OF THE UNIVERSE.



## P A R T   I I.

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HAVING finished my preliminary remarks, I will enter upon a plan of analysis of the material creation, which I trust may throw new and additional light upon the footsteps of the Creator. To do this as intelligibly as possible, I will name in detail the fundamental forces, or rather the different exhibitions of the same force, which philosophy declares to hold supreme control over matter in all its forms.

All atoms of matter are held together by a peculiar sort of force, called *molecular attraction*. This arranges molecules into masses.

All masses of molecules are held together by another form of force, called *cohesion*.

Besides these forms of attractive force,—which, acting apparently in a local and conditional manner, govern the relation of molecules, and of masses of heterogeneous composition that in the aggregate form the globe,—another form of the same force, more general and unconditional, exists, which binds all molecules, whether isolated or arranged in masses, to the centre of our planet: this is *gravity*, or *terrestrial attraction*. This arranges all masses of matter into a defined spherical form, and thus maintains them. In other words, it forms worlds.

Another exhibition of physical force, quite as wonderful and still more mighty, binds this earth and all other planets to the sun. This form of attraction is *solar gravitation*.

The remaining form of attractive power which astronomers have conjectured to exist, and which binds all systems of suns and their dependencies to some great central focal point, might with propriety be called *universal gravitation*. I have not intended to speak of the action or results of *this* force particularly; but, if the views of creation, which have been awakened in my mind, be true respecting the earth and solar system that are mainly within reach of observation and mathematical calculation, then, as complete harmony reigns throughout the works of God, the same great laws will appear to preside over the entire universe.

The principles on which I shall attempt my analysis of the material creation will be based on these different exhibitions of force which have been long known, and admitted to be governing properties of matter. The first two are familiar to com-

mon philosophy. With the last three, astronomers are especially familiar, as they form the basis of the mathematical truths which so highly distinguish their sublime studies.

The necessity of the most rigid analysis in these researches must be admitted, because the truths sought are sublime in character; and, once established, their importance will be as valuable to science as the great planetary laws unfolded by Copernicus, Kepler, or Newton. The views which have been deeply impressed upon my mind do not conflict with the discoveries of these remarkable men; but, if true, they will enlarge the field of natural laws, and give a new impulse to scientific inquiry in searching out the wonders of the worlds above and of the earth beneath.

The largest and most accurate results in mathematics, are arrived at by using an assumption as the basis of calculation.

Even Kepler's laws were established by the most laborious researches of this sort; and, in a branch of inquiry so purely philosophical as that proposed, while I govern myself by strictly inductive argument, based on facts, it must not be expected for mathematics to take part in the analysis, but only in the establishment of the great truths promulgated. Facts and philosophy must reveal physical truth; further observation and mathematics confirm it.

The course which I purpose to adopt, to make my views the most intelligible, is to unbind, one by one, the forces of nature, and set matter completely free; and to present it to the mind unsubjected to the control of any physical law. To annihilate at once all the attractive and gravitative forces would confuse the argument, and we should arrive at less satisfactory results. To connect the analysis of

our solar system with that of other systems would render inquiry complex, and embarrass the understanding.

I shall, therefore, at present suppose that our solar system is the only and entire universe, excepting immensity of space; that the whole stellar creation has no being, and that no physical force depending on or derived from it exists; in a word, that the sun and its planets comprise the whole creation, and are uncontrolled by any external law. By this position, I unbind the solar system from the law of *universal* gravitation, and the sun would be its central and a stationary body.

In the second place, suppose the power of *solar* gravitation, and all planetary attraction, so far as they control the motion of the earth, to be suddenly and entirely suspended. The result would be that the earth would quit its orbit, and move indefinitely in a straight line. Thus it is

wholly free in space, and is uncontrolled by any external law. It rotates on its axis, and is bound together by the extraordinary internal forces of gravity, cohesion, and molecular attraction. Suspend the action of these forces one after the other: what will be the result? Take away gravity; the whole mass immediately expands to an indefinite degree. Destroy cohesion; its rotatory motion rends it into fragments. Those forms of matter, as the metals, which, in the present state of the globe, are the heaviest, would become equally light as the most attenuated substances. All solid or sensible form of matter would be resolved. Annihilate molecular attraction; the ultimate atoms (still possessing a repulsive principle) would be wholly unbound from each other, and would exist in the most simple, attenuated, and aeriform condition; so infinitesimal and so indefinitely ultimate, as to defy all reason or

imagination to give them form or being, or even the susceptibilities of motion or activity. That would be the ultimate divisibility of matter.

This is a reasonable and just conclusion from all the assumptions laid down. The results of abrogating all these natural forces would be as positive as is the existence of present forms of matter governed by these same forces. Let them all be abrogated at once, and let this suspension be applied to all the revolving spheres in our system : the result would be their dispersion to remote regions of space ; the immediate expansion of their masses, as they receded from the sun ; their simultaneous dissolution into fragments, and into the ultimate and simple condition of their primordial molecules.

Thus all the cosmical bodies of this system, except the sun, would be reduced to their original elements.

In resolving the *sun* back to its original elements by the process which has been adopted with the earth, it will be observed that we set at liberty forms or properties of matter which differ from those composing the planets. That form of matter which has been created as the vast store-house of light and heat for its attendant opaque spheres, is to radiate in all directions its material, subtile, and self-luminous molecules. Its own solar gravity being annihilated, its mass expands indefinitely. Its rotatory motion rends it to pieces; and its luminous and opaque fragments, material and gaseous, are projected in all directions, from its centre towards the confines of the solar domain. The cohesive and molecular forces being abrogated, the whole solar orb would be dissolved into its original highly attenuated and self-luminous elements, and be mingled with the elements of the other cosmical bodies.

The hidden forces of *repulsion*, by which the sun, as an orb, possesses the wonderful powers of sustaining the revolving spheres at certain and definite distances from itself, would still attach to its ultimate particles ; and the same differing polarity would exist in the molecules filling up infinite space, which at present exists among all the bodies constituting the solar system.

By this method of investigation, we can just as certainly arrive back at the original condition of matter, and prove that the planets had no existence as spheres at some unknown age of the universe, as we can demonstrate, by removing stratum after stratum of organic remains, that, at some former age of the earth, there was neither animal nor vegetable life upon its surface. One fact is quite as certain, and almost as demonstrable, as the other. Observation of geological facts proves the latter. The powers of logic and mathe-

matics, in the solution of physical laws, establish the former.

Having attained, by the preceding method of research, what I believe to have been the original and differing condition of the material molecules at present composing the solar system, I shall assume it as a fact, and commence the constructive part of my argument.

The assumption, then, on which I base my theory of the universe is this,—that the matter constituting the present solar system was, at some incalculably remote epoch, diffused throughout space, and existed only in the most attenuate state of being; and that the forces which now control created worlds had not been ordained to exert their energies on the primordial molecules.

Scientific research proclaims the sun to be a mass of matter, differing in funda-

mental properties from the opaque spheres which revolve around it. Its position, as the central body of the solar system, controlling the motions and phenomena of all bodies external to it, demonstrates its origin to have differed from theirs, and to have been a more important act of creation. It is self-evident that the sun, or the universal energy residing in its centre, must have been created and *located* antecedent to the existence of bodies dependent on it for their support.

Divine Wisdom having *located the solar focus*, and originated *solar gravity* (not that force called solar gravitation, by which planets are drawn to the centre of the sun, but its internal, accumulative force, on which its special material creation depended), the material particles, subject to this peculiar attractive power, felt its influence, and concentrated around it, as grains of ferruginous sand fly towards loadstone.

The energy of this local force was communicated simultaneously to the extreme boundaries of solar empire; and all matter obedient to it converged to the solar focus. The molecular and cohesive forces exerting their power also, the vast, opaque, solid solar sphere was in due time formed; and around it flowed oceans of gaseous fluid, intensely refulgent. These envelops must be composed of the last and most aeriform molecules, which were elected by solar gravity to compose the sun.

At this period,—the close of the sun-forming epoch,—probably originated that numerous class of eccentric and curious bodies which so astonished mankind in past ages, and whose character has defied the researches of science and philosophy.

I will consider at some length the nature of these bodies, as it is in connection with them that I venture to propound the existence of a law which applies equally to

all revolving spheres in the solar system, and to the whole universe of cosmical creations. I present it with conflicting feelings of doubt, delicacy, and confidence. The first have embarrassed me, because I possess not that measure of knowledge requisite to determine the mathematical details of its applicability. The second have oppressed me, because it seems like innovation in a science whose wonderful problems have been solved by genius of the highest order, on principles of celestial mechanics, considered sufficiently accurate to yield the most truthful results. But I have been at last emboldened, because it was my conviction that some great, secret agency was lying behind unexplained phenomena so sublime and gigantic in character, that a universal force alone could produce them; and that an ever-active principle of *universal repulsion* was as necessary for the stability and harmonious

developments of the universe, as the beautiful Newtonian truth of *gravitation*. Mutual attraction and mutual repulsion, local and universal, are twin principles lying in opposite points of the great circle of physical events. They are inexhaustible fountains of power, between which hang atoms, globes, suns, and systems, striving for equilibrium; refreshing their ceaseless motions with new forces, and accomplishing silently, from cycle to cycle, the inexplicable destinies of their creation.

In like manner as the opaque and solid mass of the sun resembles the opaque and solid condition of the planets which revolve around it, so does its refulgent gaseous envelop, with its radiant zodiacal light, resemble the cometary bodies and their luminous appendages. Comets, in all their elements, plainly direct our conjectures to trace their origin to solar sources.

What does the eccentricity of their orbits indicate? That they originated in the remotest confines of the solar domain, and that the atmosphere of the sun was drawn from regions, as far at least as they can recede into space. What do the various degrees of inclination and obliquity of their orbits to the plane of the sun's equator indicate? That the elementary molecules, constituting the great central body, became obedient to the creative forces of molecular attraction, cohesion, and solar gravity, in all directions from its centre. What do the varying orbital motions—almost as frequently retrograde as direct—indicate? That their formation took place under different circumstances, and probably at a different time, from the formation of the planets, and that they were created in direct relation to the sun; and that, as luminous masses, destined to make up the bulk of the solar atmosphere, they were

arrested by sudden repulsive forces, and diverted into orbits of endless irregularity. The various and highly eccentric forms of their orbits; the endless diversity of inclination and obliquity of these orbits to the plane of the sun's equator; the equally frequent retrograde and direct motions of these bodies themselves, as well as their physical nature and appearance,—all declare, with unmistakable significance, that their origin differs altogether from that of the planetary orbs, and that they are more nearly allied in nature to the gaseous envelops of the sun than to any other form of matter in the universe.

Now we will examine these extraordinary gaseous spheres more in detail. When very remote from the sun, they all appear alike in form, and no diversity of nature is observable in them. The further they recede from the sun, the more they expand in bulk; their outline becomes less defined; they di-

minish in refulgence, and fade away entirely from the sight. It is only when comets approach the sun, that they exhibit peculiar and astonishing characters. When near enough to be observed with mathematical distinctness, they are seen to diminish in size, to grow brighter throughout, and become more defined in their circumference, and more dense and luminous at their centre. Sometimes suddenly, sometimes gradually, a train of light, varying in appearance in different comets, is projected in a direction opposite to the sun. This increases in brightness, size, or length, and the whole sphere in refulgence, until it passes its perihelion, when all these extraordinary phenomena, which have been awakened by solar influence, gradually grow less marked, until the comet is resolved to a pale, misty, loosely-defined gaseous sphere, dilating as it advances into remote regions of space. What are the solar forces which occasion

the change in absolute dimension, the increased density and brightness of the centre, and the wonderful luminous appendages, of this class of celestial bodies? To facilitate research, this inquiry may be divided into two parts. What power causes a contraction of comets, and an increased density and brightness of their centre, as they approach the sun? and why do they expand, and become more rare and less refulgent, at their centres, as they recede from the sun? The elucidation of this question must form one of the most important investigations in astronomical science, and lead to the establishment of a celestial law, equal in importance to that of gravitation, and ranging, side by side, with it, in all calculations of the motions of the heavenly bodies.

Philosophical study, and experiment on various forms of matter composing this planet, have made us acquainted with the

fundamental principle, that no two molecules are in absolute contact with each other; that they are endowed with forces of attraction and repulsion, which maintain them at fixed distances from each other, and restore them to this state of equilibrium, when it is disturbed by external causes.

This is an established law, underlying all the exhibitions of physical force within human observation, chemical affinity, molecular attraction, cohesion, adhesion, and terrestrial gravity. It is clear, if such a law preside over the structure of a grain of sand, it must also over that of its parent rock, and so over that of the whole mountain mass from which that rock was torn, and so throughout the structure of the whole globe. However movable the fluids composing the ocean or atmosphere, the same principle prevails in their molecular relations. Whatever the form of matter,

however subtle, however dense, there reign the antagonistic energies of this law.

This being an established physical law, it must prevail universally throughout the entire realm of matter.

The material constitution of comets has never been questioned: all telescopic observations, all analogies, prove their *nuclei* to be of a more or less dense molecular structure. If so, then their entire mass must be subject to contraction and expansion, depending on the mutually attractive or repulsive condition of their constituent molecules. For a change of this sort to be aroused throughout their entire molecular mass, from centre to periphery, some all-pervading and omnipotent disturbing force must be exerted. As comets approach the sun, they contract in volume; as they recede, they dilate. The disturbing power, then, which causes this visible and remarkable change in their dimensions, lies in the

central body. What is it? It is a force which evidently acts on the revolving bodies, in the same manner as mechanical pressure acts on matter under human control. I call it *cosmical repulsion*; and I hope in the sequel to demonstrate its action on the solid planets, as positively as we see its exhibition on the gaseous spheres. The promulgation of the idea will create profound and candid inquiry in various ways; and I trust to future observation, more than to my present argument, to establish the truth of a universal law, like the following:— *That cosmical spheres possess a power of repulsion, by which they are prevented for ever from falling together, and by which they are sustained in their orbits, at fixed distances from the sun;— in other words, that all cosmical spheres possess a vital centre, from which is constantly radiating repulsive forces, acting on similar and distant spheres, in proportion to their size, density, or other physical susceptibilities.*

Comets being of a gaseous character, the mobility of their molecules must be very sensible and very free. Being as subject to the great law of solar repulsion as the planets, they show a positive and perceptible change in their volume, which cannot be so easily detected in the planets, in consequence of their great density. Besides, possessing a near resemblance to the solar atmosphere, and being governed as much by relations to it as to the sun's opaque mass, they are more easily acted on by light and heat, or the electric forces of the solar rays. Impelled by the great law of attraction, these cometary bodies fell from the regions of space, where their materials had been condensed, in a straight line toward the centre of the sun; and they continued to fall, until they began to encounter the influence of the antagonistic law of repulsion. At this point, they began to deviate from the straight line; and their

course was bent into a curve, more or less modified, according as the repulsive influence exerted between these bodies and the sun affected the projectile or gravitative motion already imparted to them. Thus they advanced toward the sun with accumulating velocity. Feeling more and more within their mass the influence of a solar force acting like repulsion, their molecules condense, and gather more compactly around their centre; and thereby they acquire an accumulating tension, and more energetic repulsive forces of their own. By the self-regulating energy of their own central powers, they are constantly maintained at definite distances from the central body. Meantime that central body is drawing them forward with a power increasing in intensity as the squares of their distances diminish. An accumulating repulsive action is generated in these bodies, at the same time that the

positive and predominant agency of the sun is exerted to draw them toward itself. In this manner these antagonistic forces exert their energies, and in a measure control each other, until comets attain their nearest possible approach to the sun. At their perihelia, these antagonistic forces exhibit their greatest power; and, having been impelled into relations wholly at variance with an equipoised condition of these forces, the moving spheres must change their position by an imperious physical necessity. Once in motion, celestial bodies must continue to move through all time; and so these bodies would recede from the sun, moving conjointly by radial repulsive influences, and the momentum imparted at their perihelia; which momentum would be the accumulated velocity acquired during their fall to their perihelia, from that point in space where their foci of atomic agglomeration were located by

the will of God. Never relieved from solar attraction, their receding motion is necessarily a curved one, and at last they fall into that path which they assumed when first forced to deviate from a rectilinear course. The path of a revolving sphere once defined, there it must remain for ever, unless modified by the influence of some disturbing forces.

On the principles of this illustration, it appears to me that the celestial motions may be calculated with more simplicity; and that phenomena which heretofore have greatly perplexed astronomers, and which even now are not explained without difficulty, may be rendered harmonious and satisfactory.

In expressing so concisely the preceding views on the causes of the contraction and expansion of comets, and the alternating density of their *nuclei* as they ap-

proach and recede from the sun, I hope to have been sufficiently clear for the reader to comprehend them. Being new, and difficult of explanation, they may be better understood perhaps after the examination of similar changes which take place in the solid planets. The increasing and decreasing brightness of their *nuclei*, as they approach or recede from the neighborhood of the sun, coming more properly under the second division of the question, I shall unite that subject with the inquiry into the nature of the luminous appendages which distinguish some of these eccentric and wonderful bodies.

Astronomers, without exception, cannot, so far as I am informed, divest their minds of the belief that the tails of comets are material, and are composed of matter similar to that constituting the nucleus, and that they are poured out from it. I hope to be able to give a new direction

to inquiry, and to make an important suggestion, on this interesting subject. The simple fact, that these appendages sometimes appear and disappear under the observations of the telescope, and always in a direction opposite to the sun, should be sufficient to destroy all belief in their material constitution, or that they were composed of material emanations from the nucleus.

Comets contract in volume, become more defined in their circumference, brighter throughout, and particularly bright and more dense in their centre, as they approach the sun. These characteristics all grow more intense, until the comet passes its perihelion, when they gradually diminish, and the comet fades away into an ill-defined, misty spot, which finally is lost in space. The question is, What are the solar forces which produce these luminous phenomena ?

I have already shown with great probability, that the physical structure of comets is similar to the gaseous and luminous fluids which surround the sun, and that they are vestiges of the primordial molecular masses which were drawn towards the sun to constitute its envelop, becoming endowed, by laws attached to that form of matter, with central forces of their own, by which they are maintained at fixed distances from the sun, and revolve around that orb.

The present state of knowledge allows us to believe that the sun is an opaque, solid globe; that one stratum of its atmosphere is intensely refulgent, and the source of rays which, highly endowed with calorific, luminous, and electrical forces, stimulate with kindred powers all the spheres which revolve around it, and on which these rays fall. Why should comets not feel the stimulating influence of these

rays, as well as the gaseous envelop of our own globe? and why should not chemical, electrical, and mechanical action be excited among their molecules, as well as on the surface of this planet? There are certain forms of transparent solid matter on this earth, which, exposed to the rays of light, reflect and refract those rays with intense resplendency; and not only so, but absorb them so as to radiate light for some time afterwards. Why, then, may not forms of matter, which are allied in composition to the luminous envelops of the sun, receive such impressions from its rays as to stimulate their natural forces, and thus to renew the energy and luminous character of those rays, and transmit them beyond into infinite space with all the velocity of light emanating directly from the sun? Such I believe to be the case, and a reasonable explanation of the tails of comets. The various forms of these

appendages, and the fact that some comets possess none at all, furnish data for the study of their physical constitution.

In examining particularly that class of comets exhibiting tails, we find the various degrees of transmitted light to produce all the effects which have been observed in these bodies from remotest time. The great accumulation of material molecules at their centres—in other words, the density of their centres, though increasing their direct light, does not allow so free a transmission of solar rays, as the more diffuse condition of their exterior parts. Hence the hollow appearance of the tails of various comets, and the more intense luminous appearance of the upper and lower portions, or the double tail. A certain degree of density, or chemical constitution of the transparent particles, would produce the refrangibility of solar rays, which, in some comets, have projected

tails formed like a fan. Any form of luminous appendage may be explained on this hypothesis; and it may even be presumed that the same comet will present different appearances at different times, in consequence of the extreme mobility of its constituent molecules, and of their differing relation to each other at various times.

The interesting experiments of Arago, made on the great comet of 1819, and on Halley's comet in 1835, with the polariscope, sustain these opinions of the nature of comets with singular force. He showed that only a very small portion of the cometary rays, which strike our eye, are reflected from the sun. It may be strictly said, that, with slight exception, comets shine with direct and not reflected light. This is an astonishing fact, and of great weight in this inquiry. The planets and moons all shine with light reflected from the sun. The sun, comets, and stars all shine with *direct*

*light*, — that is, with light not reflected from another body, but generated within themselves. These experiments of Arago are of immense scientific value, and, with the contemplations herein presented, may throw new light on the physical constitution of comets, and open a new path of astronomical inquiry, which may lead to brilliant discoveries as to the original, as well as to the present, physical constitution of the universe.

Some comets exhibit no tails. This fact shows a difference only in their physical structure as a peculiar class of bodies. The sun has several gaseous envelops: one is self-luminous, and radiates its light with intense power and activity; another is misty, and would not transmit direct light, unless illuminated and stimulated by the power behind it. So with this variety of comets. They receive the direct action of the sun's rays, which immediately illu-

minates them ; and the nearer they approach the central body, the more strongly their internal forces are stimulated, and a self-luminous property is generated within them. In fact, they may never be destitute of this property, and probably are not. But, like all other revolving spheres, their internal forces sustain definite relations to the great central solar forces, in proportion to their distance from that centre. As they draw near the sun, they feel its influence. Their powers for generating light, or renewing the energy of the rays which penetrate them, are stimulated by the presence of these rays. In one, the rays are absorbed, and the whole sphere becomes very luminous, and radiates its own light, in the same manner as the sun or the stars. In another, the rays penetrate and impart new and intense power to the mass ; and the luminous and radiant forces of these rays are resuscitated by the molecules endowed

with properties similar to those in the sun from which the rays emanated; and away they dart with refreshed energy, so as to brighten space, in some instances, forty millions of leagues beyond the relay at which their luminous power was intensified. In another, some peculiar atomic constitution diverts the transmitted solar ray; and it is projected laterally, and in directions at various angles to the rectilinear ray proceeding from the sun. Difference of chemical composition might even induce varieties in the color of transmitted rays; and no color and no form of appendage have ever been observed or can exist that may not be accounted for on my imperfect exposition of the physical nature and forces of these mysterious bodies.

The orbits of comets varying in form, so much as they do, require in this connection some explanation.

In these views of celestial dynamics, the theory of centrifugal force is not entertained in the sense in which it was originated by Huygens, and has since been used by mathematical astronomers in calculating the orbits of the heavenly bodies. However accurate astronomical calculations, based on this theory, may be, it appears to me that no dead or inactive principle exists in the universe. The idea of cosmical bodies being projected at random from the hand of the Creator with prodigious and variable forces, and afterwards caught up by the attractive power of the sun, as they were rolling by that orb in a straight line directed to no particular object in the universe, is not consistent with the order displayed so universally in the works of nature. There were living organic forces instituted in the morning of creation, and they were the most simple that Infinite Wisdom could devise. The same that

were exerted to form the universe continue to maintain its stability and harmony. The Infinite Principle was to create, not to destroy. The tendency of matter, whatever its condition, whether in isolated molecules or in massive spheres, has always been to form some attachment, to seek some central point or nucleus, never to fly from it; to be aggregated, never to be segregated. It may be prevented from reaching that centre by a force inherent in all molecules and spheres,—a force coincident with and nearly as wide in its operation as that of attraction; and the idea of that force is expressed by the word *repulsion* as well as by any word in our language. Vast accumulations of matter, moulded into a cosmical sphere, and falling for thousands or millions of miles towards a central body,—even though a repulsive influence were exerted between them,—might be impelled into such relations with

the central body as to be incompatible with the equilibrium of the opposite forces with which their constitutions might be endowed. Under such circumstances, they would recede from the focal centre; and, if carried beyond the equilibrium of their forces on the other side, they would return toward the central body again with the same velocity as at first, and thus their unequal motion would always be sustained in consequence of the first organic act of the Almighty.

Galileo discovered the axial rotation of the heavenly bodies; and the idea that some projectile force had imparted a rotatory motion to the planets led Huygens, with his lofty mathematical genius, to imagine the existence of a principle of motion, to which he gave the name of *centrifugal force*. On this basis, embraced within Huygens's celebrated theory of central forces, the immortal Newton, having had

revealed to his mind the beautiful truth of gravitation, established by the most laborious mathematical calculations the sublime principles of celestial mechanics. To account for the elliptical form of planetary orbits, the existence of which was first discovered by Kepler, he combined the motions growing out of these two ideas; and, from that day to the present, the powers which sustain revolving spheres in their orbits have been called centrifugal and centripetal forces. The latter only, exists in the minds of philosophers as a living radial force, exerted actively by central bodies to draw revolving orbs to their foci. That is Newton's discovery, and it is the active operation of the law of gravitation. The present state of philosophy admits no vital principle to reign in the action of the centrifugal force. It exists in the eye of science, only as a result of some ancient and mysterious impulse communicated

to inert masses of matter moving in space.

Now, let us examine more particularly the nature of centrifugal force. It was imagined to exist by Huygens, has been inculcated by Newton, and taught by philosophers to the present day as a force acting on revolving orbs independent of any radial connection with the central body. The annular hypothesis of Laplace would indeed imply, that the solid revolving bodies had been impressed by a centrifugal force during their former physical connection with the central body: but, since their separation from that body, the same force continues to be exerted upon them as though they were masses of inert matter, and possessed no internal radial properties by which their orbital motion could be in any way affected, — either increased or retarded. If the doctrine of universal repulsion, which I have ventured to propound

in this treatise, be sustained by the scientific developments of the age or of futurity, then the "centrifugal force" of modern philosophy immediately assumes a life and energy which it has never heretofore possessed; and it becomes a force acting conjointly with attraction, and is an active radial property of cosmical bodies as positively as is attraction itself.

The centrifugal or tangential force acting on spheres revolving in space has heretofore been held in the light of an assumed quantity, which, combined with a force clearly demonstrable, has wrought out a compound motion necessary to the existence of curvilinear orbits. Unlike the idea attached to centripetal force, which implies an absolute radial principle manifested between the central and revolving orbs binding them together, the idea attached to centrifugal force embraces no innate active principle, and refers only to an

ancient impulse not even dependent for its origin on attraction, and which was communicated when the sphere was at rest and inert. The doctrine presented in this treatise assumes that the primordial molecules floating in space, not being inert when they agglomerated, carried their internal principles of motion into the massive spheres, which, thus endowed with central forces capable of external and radial influences, are not to be viewed in the light of inert bodies whose motions can be compared to those of objects twirled in a sling or projected from fire-arms. On the contrary, all their motions, from the moment when their molecules began to agglomerate, arose from internal principles augmenting in power in proportion to their mass. Thus attraction, possessing a wider circle of influence than the opposite principle, was the first to exert its force as an organic power, and to move the mass. This uni-

versal principle held complete dominion over the universe during the earliest stages of its cosmical developments. It acted as a radial power from sun to sun, and was the active agent of that vast condensation of worlds so beautifully exhibited in the northern and southern hemispheres, and increasing progressively in numerical extent from the poles to the equator of the galaxy. As the repulsive principle was less efficient in its energies at first than the attractive, and allowed agglomerations rather than maintained a diffuse condition of the primordial molecules; so, after these agglomerations had taken place, the attractive principle extended its power from sphere to sphere in such a manner as to impart an impulse to all; and that impulse, at a later period, was met by the repulsive power which acted as an opposing force, and created the compound motion necessary to form the

planetary orbits. The repulsive principle so exerted its influence as to compel the falling bodies to maintain definite distances from the central focus ; but, the attractive principle having accumulated power in proportion to the fall of a cosmical body for millions of miles before it encountered the repulsive force, it still continues to approach the central focus, and to overcome the antagonistic principle. During this period, it is being impelled into relations with the central body wholly at variance with the equilibrium of the forces emanating from the two bodies ; and, when it has attained the nearest possible point, a reaction must take place ; and, on an inverse application of the principle of Newton's third law, that "action and reaction are always equal and contrary," — a principle, however, never applied by him in this manner, — it must necessarily recede from the sun. Here, repulsion, manifesting itself as

an active and predominant principle, becomes an absolute, living, centrifugal force; and the receding body is carried to its aphelion by active radial influences exerted between the moving and central spheres, aided by the momentum accumulated by the former in falling to its perihelion. No force is exerted in space capable of impelling planets out of their orbits, except repulsion; and that, as a living, radial principle, is limited in its power to a circle, whose radii, proceeding from the centre of the sun, are equal throughout. Relieved from attraction, revolving bodies would necessarily leave their orbits, and at first move away from the sun in a curve, not at a tangent; and, abandoned to the principle of repulsion, they would recede, and expand indefinitely, by virtue of radial influences exerted throughout their mass and beyond it, whose energies would only die away in space, when they had attained

that distance from the sun where this force was first awakened in them.

The lofty powers of Huygens, Newton, and Laplace, — in every thing laborious, and in so much truthful and exact, — have controlled the direction of philosophical thought for a long period. But, illumined by light radiated from various branches of science during the last forty years, it may be a question whether some of their doctrines might not with propriety be re-examined for the purpose of confirming or modifying them, in accordance with the evidence of modern discovery. Thus the “nebular theory” of the universe, promulgated by Laplace, — a sublime and beautiful idea, — has governed the opinions of the learned to this day; but it fails to account for the existence, and for the eccentric and retrograde orbits, of comets, — a class of revolving bodies infinitely more numerous than the solid planets.

When applied to them, his hypothesis, and the direction of the centrifugal forces naturally growing out of it, are wholly inconclusive; and the retrograde motions of the satellites of Uranus, so long observed by Sir John Herschel, throw additional obstacles to the admission of its correctness.

The proposition herein presented has grown out of contemplations of Newton's universal law of gravitation, and of Mosotti's equally beautiful suggestion, that all molecules are surrounded by an elastic ether; and that they may approach or separate from each other within definite distances, as they may be influenced by external circumstances. From this theory of molecular repulsion my mind has been led to conceive of a principle of universal repulsion, less extensive in the circle of its power than gravitation, but associated with it, as a radial influence, in all worlds, and so acting as to control their motions,

and to sustain them at fixed distances from the sun and from each other. If a principle of attraction, presiding over molecules, assume a ponderous and multiplied power when these molecules are congregated into vast globes, so as to create the principle of cosmical attraction, then the opposite principle of molecular repulsion must assume an equally multiplied force, and thereby create the mighty powers of cosmical repulsion, so as to hold all globes at definite distances from each other; and these distances will depend on the quantity, density, and peculiar properties of the matter constituting the various bodies.

Thus in the beginning, foci of attraction being established by the Creator, the primordial molecules fell to them without obstruction. Chemical and cohesive forces acted simultaneously, and different combinations of molecules ensued, the action of which upon each other would be to gene-

rate successively the various voltaic and electrical forces which are now performing such important agencies throughout the material universe. By this process, the great central body was created, whose powers exert such wonderful effects upon all the bodies which revolve around it. Thus the suns were formed. But the creative energies once exerted, and subordinate foci established, the thought of God to form the universe was perfected.

Having premised thus much to elucidate more clearly the existence of a power, which, combined with that of gravitation, will explain the peculiar forms of the orbits of planets and comets, I will proceed to account for the varying and eccentric forms of those of comets.

The gaseous matter of comets, as soon as collected around their foci (in most instances on the extreme confines of the

empire allotted by creative Wisdom to solar influence), would begin to fall toward the sun. The sun's attraction being the accelerating force, the velocity of these bodies would constantly accumulate; and, unless diverted, they would fall in a straight line directly on the sun. Governed by the laws of accelerated motion, their velocity would become prodigious, and they would rush on, regardless of the first impressions of solar repulsion. At last, feeling this too sensibly to be longer disregarded, they would deviate from a rectilinear course; and, partaking of the mysterious influence of the universal sidereal motion, they would fall into a curvilinear direction, and advance from west to east with accumulating velocity. Though deflected, their object is still to reach the sun,—the attracting focus; and to that their accelerated velocity impels them. Their momentum overcomes, to a certain

extent, the antagonistic repulsion; and they continue to approach the sun, until they attain that point in their course where the power of repulsion renders it impossible for them to approach nearer. This is their *perihelion*. Here they move with a momentum, which, together with mutual repulsion, carries them onward, and the sun's attraction still restraining them, their motion is a curved one; and the elliptical form of the orbit, and the sun's position in relation to the circumference of that orbit, are necessary consequences of the compound action and alternating intensity of these two forces of attraction and repulsion. Once established, the orbit must remain the same for ever (except influenced by external agencies), inasmuch as it was first instituted by fixed laws, and was dependent for its elements on the amount and specific forces of the matter subjected to solar action.

It is quite clear, when the revolving body had attained the extreme point in its course, diminishing in velocity according to the law regulating uniformly retarded motion, it must commence its course anew toward the sun, with that momentum which it acquired in falling in a straight line, to the point where it first felt the influence of repulsive forces. This point is the *aphelion*.

This explanation, applied to the revolutions of the solid spheres, whose orbits are more regular and circular, will be readily appreciated ; and, on reflection, it will be found equally applicable to the orbits of gaseous bodies. These bodies being so sensible to perturbing forces, the form of their orbits would greatly depend on the influence which they received from disturbing causes, immediately or soon after their creation. Composed, in most instances, of material differing but little from the

gaseous and light-giving molecules of the sun, condensing in very remote regions of space, and converging in all directions toward the solar centre, — the original direction given to their motions would perhaps be independent of the proper sidereal motion communicated so generally to the planets and their secondaries. If not entirely independent of it, they would be more sensible to perturbing influences than the solid spheres, and might as readily be drawn to the right as to the left, after having commenced their rectilinear course toward the sun. The planets, in an unformed state, even before they had approached the sun so far as to have been deflected from *their* rectilinear course, — in fact, even before their heterogeneous elements had accumulated around their attractive foci, — might have presented a sufficient disturbing force to have drawn a comet from its rectilinear course. If de-

flected, the slightest sensibility to solar repulsion would give them a curvilinear direction, and the resulting orbital motion would as probably be retrograde as direct. The position and direction of the perturbing force, at the moment of deflection, would decide the character of the comet's motion, and the elongation of its orbit; for, when the comet was so remote as to feel but slightly the force of solar repulsion, its inclination to the curve would be only slight, and it would hasten on to the central focus with accumulating velocity. This point of deviation from its primitive rectilinear course would be not far from the point of its future aphelion, when its revolution had been accomplished, and its orbit established. A line, projected from the longer axis of the orbit, would meet the point where the comet first received its disturbing influence; and such a line, projected still further, would ultimately reach

the point in space where the attractive focus of that body was located by the Creator. Did the comet encounter no lateral disturbing force, it would move in a straight line to the sun, as before stated, until the repulsive principle was awakened, so far as to allow it to advance no further in this manner. Then it would assume a curved motion more suddenly, in consequence of the combined action of the two forces; and the aphelion of such an orbit would probably be the point where the deviation first took place, and the form of that orbit be more or less elliptical. But, where the comet was diverted from its rectilinear course, at a very early period after it began to fall toward the sun, its orbit would be proportionally elongated, and might be a parabola or an hyperbola, according to the degree of repulsive influence exerted upon it, or by it, at the time of its deflection from a rectilinear course.

In this connection, and before I complete my remarks on these singular bodies, it will not be inappropriate to make a suggestion upon the question which so deeply agitated mankind in unenlightened ages, and which is still unsettled among scientific men,— Can comets come into collision with the earth? The reply to this question, based on the foregoing principles, is that they cannot come in direct contact with any other body possessing active radial forces in the universe. All cosmical bodies, once created, are endowed with central forces as peculiarly and unalterably their own, as the forces which attach to molecules are peculiarly theirs. One cosmical sphere attracts another, and they are bound to each other by certain relations; but these relations are such, that when, in the course of cycles, the orbit of one will so incline to and cut the orbit of another that the two bodies, if pursuing their regu-

lar courses, would come in collision, they would both exert their repulsive forces; and one would be retarded, and the other accelerated, in their respective courses, and all possibility of contact avoided. Thus, should it so happen that the course of a comet was such as to advance directly to the earth, the comet, when within a certain distance determined by their respective central forces, would feel the power of terrestrial repulsion, and be at first retarded; then such a degree of perturbation would ensue as to modify the curvilinear form of its orbit, until it had passed beyond the earth's influence, when it would resume its original motion. The exertion of its own radial principle of repulsion would probably be attended by a condensation of its molecules, in the same manner as they condense when these bodies are near the sun; for it would seem necessary to the exertion of strong repulsive force, for the molecules of

which even cosmical bodies are composed, to be drawn nearer to each other in proportion to the exertion of that innate force. By telescopic observation of comets, as they approach and recede from the sun, this appears to be a law of their spherical existence ; and I venture the prediction that future observation and research will determine the same law to attach to all the solid globes, in definite proportions to the quantity and density, or peculiar physical characters, of the molecules which compose them.

The phenomenon observed to take place in Biela's comet of 1845, whereby it disunited its physical elements, and assumed the condition of two distinct spheres, is certainly very remarkable, and not easily explained ; but, as this change occurred during its recess and course of molecular expansion, it is possible that some violent internal action, subordinate to solar influ-

ence, might have rent asunder elements of opposite polarity.

It has not been my intention, in this treatise, to attempt to explain all the phenomena and appearances connected with comets. My object is to unfold only what I have believed to be important and immutable truth, to open fresh and fertile fields of observation and inquiry to minds more highly endowed than my own, and to invite the attention of physical astronomers to what may possibly be a valuable basis for mathematical calculations. I may be considered presumptuous in thus rudely invading provinces of learning, which have been so profoundly cultivated by the highest human genius; but when what we have long felt to be great truths demand utterance, and our object is to enlarge the boundaries of human knowledge, and to give impulse to research in new and unexplored directions, we feel sure

that our views will receive the indulgence of a candid consideration from the learned, rather than their too hasty condemnation. Science is still imperfect. No department of human inquiry has been so thoroughly examined, that every thing is revealed to our understanding. Much less so with astronomy. Encke has felt convinced, while calculating the path of the comet which has received his name, that it was encountering some resisting force, and has, in consequence of this conviction, imagined space to be filled with a resisting medium. Signs of resistance to the progress of the heavenly bodies have been perceived by various astronomers, both observers and calculators ; but all have been fettered by the sublime idea that gravitation was the only active universal principle, and that a centrifugal influence was only a negative energy, having been exerted at that remote epoch in the history of the universe, when

the various revolving spheres were projected into space, or thrown off from the sun, and is now, so to speak, a dormant projectile force. Astronomers have been so enchained by this lofty mathematical tradition, that the grand and immortal truth of cosmical repulsion has never been awakened in their minds, or entered as an element into their calculations. I say this with all humility; and though centrifugal force, as a dead element, has been substituted for it, and with great mental labor might be made in a manner equivalent, still, in the nicest calculations, it will be greatly deficient, and, as a basis of calculus, must fall far short of the positive and natural power.

I have already stated, with sufficient clearness, my theory of the original state of matter, and of the establishment of local attractive foci, to make it unnecessary to

enlarge further upon that subject. I wish now to invite attention to the more solid spheres which revolve around the central body.

The solar focus being established, and endowed with the peculiar principles which Infinite Wisdom devised to draw around it those molecules destined for the sun's special creation, and which were to hold all other elementary forms of matter at fixed distances, and in complete obedience to it, the foci of subordinate though similar principles would necessarily form the basis or skeleton of the present solar system.

To impart a more clear understanding of views herein presented on the formations of planets and their secondaries, it will be necessary to consider the creation of the earth as concisely as possible, and apply knowledge derived from facts to the elucidation of the mysteries which are, in a great measure, beyond our reach.

Here every thing is subject to our touch and examination. We can solidify aëri-form substances, and dissolve into gas rocks and metals. The most delicate investigations of the great forces of nature can be devised by the enlightened intellect; and the separation of forces and elements into their simple and ultimate conditions can be carried to an extent which unveils the mysteries of creation, and transfers us to that epoch in the history of the universe when matter had received no form, and when the germ of its consolidation was only a thought in the bosom of the Supreme Being. How vast, how marvellous, the amplitude of the human understanding!—a principle so nearly allied to the divine, that, like images of the resplendent worlds above impressed on a tranquil sea, the thoughts of God glance upon the peaceful, meditative soul, and the Infinite is reflected through the finite for the im-

provement and elevation of the whole race of man.

The system of analysis, by which terrestrial matter has been resolved into its primordial conditions, is strictly inductive; and it affords a basis for reasoning sufficiently strong to make the views of terrestrial creation herein expressed more than bare hypothesis. Having unbound molecules from the forces which held them in such relations as constituted the various forms of matter composing this planet, we left them free and chaotic in infinite space. Let us now invoke known physical forces to exert their energies, and reconstruct the earth.

That region of space having been allotted as the theatre of these energies, they all act simultaneously and unitedly. Molecular attraction draws atoms together, which, being polarized in various degrees, constitute forms of diversified character;

cohesion accumulates masses, and terrestrial gravity attracts the simple and compound elements of nature around its central focus. Thus all this planetary matter is endowed with physical life and motion. The act is as instantaneous as the thought of God, and the result as positive and irresistible as his will. The various forms of matter falling together equally in all directions, would necessarily fashion out a sphere. To the terrible galvanic phenomena which would attend such a rapid condensation and accumulation of heterogeneous masses, I will only refer as absolute results of such world-forming energies. The molten condition of the inner portions of the globe still attest to the violent conflict of forces exerted at its creation. Collecting around the solid sphere, at last condensed the flowing ocean and the ambient air. Thus probably all the solid planets were created; for, so far as we can observe their physical

appearance, and judge of them by their obedience to laws which govern known forms of matter, they are probably not exceedingly dissimilar, and were formed on the same general principles.

So far as one class of cosmical creations took precedence of another, the inference is, from close examination of physical laws applied to facts and to probabilities, that the central and commanding forces of the suns were first ordained. Previous to this, that polarization of all molecules throughout immensity took place, which produced lateral accumulations toward a vast plane extending through the universe. This plane will be recognized as no other than the galactic zone; and the gauging of the northern heavens by Struve, and the southern by Sir John Herschel, show such a similarity and numerical uniformity to exist in the density of stars in the two hemispheres, that there can be no doubt of

the vast polarizing force exerted in the dawn of creation. Telescopic observations prove beyond a question the universal condensation of primordial matter, from the direction of the two galactic *poles* to the *plane* of the milky way. This was a stupendous action of Divine Thought, which we behold carried out very beautifully in detail, in the construction of our own solar system. Ours is suspended in the midst of the milky way, and we see all forms of matter condensed from the direction of the poles to the plane of the ecliptic. It is spread out in one broad sheet, extending from bound to bound of the solar domain; and the polarizing force which effected these lateral accumulations still retains its power over the terrestrial molecules, and is displayed in the wonderful phenomena of the magnetic poles. Nothing appears to have been left behind during the manifestation of this local or

solar polarizing force, except the wandering comet; and these mysterious bodies, by their escape, point significantly to a previous formation, or to a play of physical forces wholly different from, and antecedent to, those exerted for the consolidation of the planetary spheres.

Thus, by our knowledge of terrestrial magnetic forces, we can ascend, by analogy and inductive contemplation, to the display of these forces when the planetary molecules were in their primordial state. The effect would be to draw them together from north to south, and to form a zone extending in all directions from the solar equator.

Previous to this, all stellar boundaries had been marked out; and our sun, among the countless multitude in the heavens, had received the domain allotted for the display of its mighty external forces. Its own powers and form were given to it, and it became the controlling orb, around which this

earth and all kindred spheres were to revolve throughout time.

As the planets were made subsequently, and subordinate to the sun, and endowed with attraction and repulsion similar to the solar forces; so were the secondaries created subsequently, and subordinate to them, and endowed with corresponding principles. The stability of the system would not necessarily demand a simultaneous organic perfection of all its members; for, the focal forces being established in relation to each other, matter would probably operate in the same equilibrious manner, though not with equal intensity, whether in a dilated or condensed state. The rotation of Saturn under these circumstances, exerting its repulsive as well as attractive forces, would more naturally explain the formation of its rings, and their permanent but librating relation to each other and to the planet, than the hypothesis of Laplace, applied to

their phenomena, with the highest human ingenuity.

It is not my design to enter into a minute detail of what many might consider bold speculations, or that persons, whose knowledge is more exact and enlarged than my own, might call baseless theory. But I venture to utter opinions only so far as facts and observation will sustain legitimate inquiry; and my main object is to invite scientific minds to resurvey the past state of knowledge, and to press forward in the development of the sublimest physical truths.

Subordinate still to terrestrial attraction, is a class of bodies called *aerolites*. As comets point our conjectures to their existence as vestiges of solar matter flying towards the sun from all regions of space, so aerolites point our conjectures to their existence as vestiges of planetary matter,

which for ages have wandered around the earth or moon. As it is a physical impossibility for them to have been projected by any volcanic agency beyond the gravitative attraction of this globe, I have been led to imagine that they are creations subordinate to the moon, and that their orbits have been so eccentric to that secondary, that at last they have lost their equilibrium, and been drawn within the earth's power. If this be so, it would countenance the opinion, advanced by some astronomers, that certain comets whose return has been predicted, and which have never again appeared, may have wandered to the outskirts of the solar empire, and fallen within the attraction of remote stars.

The fact on which I base the conjecture that aerolites — or rather the original masses, of which they are only fragments — were lunar satellites, is significant in so far, that some ferruginous aerolites have

decomposed very rapidly after reaching the earth. This is strong presumptive evidence that they had previously occupied regions where no oxygen or atmosphere like our own existed. The absence of a lunar atmosphere increases the probability of the conjecture, that their origin is more nearly connected with the constitution of the moon than with that of the earth. At any rate, the fact is so remarkable that I would invite inquiry and critical telescopic observation to this point; though it is presumable, that, from the small size of these erratic bodies, they may not be discovered by the most scrutinizing and patient research.

These opinions on aerolites, however, are speculative; and I advance them because it appears to me a physical impossibility for meteoric bodies to have been projected, either by the moon or earth, beyond the limits of their respective gravita-

tive forces. If that cannot be, the inference is that they must be moving in space free as other cosmical bodies. Besides, their physical characters, though denoting a chemical origin similar to that of our earth, show a composition so foreign to it, as to direct our research for their origin beyond the bounds of this sphere. Thus I have been led to believe, that they have sustained a nearer relation to the moon than to the earth, and that they are fragments of anomalous cosmical masses, mere vestiges of a world-forming epoch, revolving in eccentric orbits around the moon under circumstances of feeble relation to it, and which at last have reached the great central focus within whose circle of forces the condensation and crystallization of their molecules were first effected.



## PART III.

INEQUALITIES OF SURFACE IN THE SOLID SPHERES  
AND THE SUCCESSIVE REVOLUTIONS OBSERVED  
THROUGHOUT THE CRUST OF OUR OWN GLOBE,  
AS RESULTS OF THE ALTERNATING INTENSITY  
OF COSMICAL FORCES.



## P A R T III.

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HAVING completed a cursory survey of the cosmical bodies composing our system, and the forces which govern their mutual relations, the changes that take place on the surface of the globe, growing out of the local and radial action of these forces, will next claim our attention. This is a subject which has not hitherto attracted the consideration of scientific men. But the sequel will demonstrate its importance; and I trust the suggestion will receive that candid and profound investigation which exact scientific knowledge demands. The means of inquiry will be wholly within our

reach ; and a few years of careful observation will determine whether I have promulgated a sublime physical truth, or indulged my imagination with dreams and mere conjectures.

Changes produced in *this* globe, from universal causes, must be only a counterpart of similar changes in *all* globes where like causes operate. This is irrefutable ; and I shall therefore announce, without further preliminary remark, the following, as a physical fact or law :— *That planets contract in volume as they approach the sun, in direct proportion to their mass and distance, until they reach their perihelia, when they are smallest ; and that they increase in volume, in like proportion, as they recede from the sun, until they reach their aphelia, where their dimensions are the greatest.*

The evidences of alternate contraction and expansion of planets are of two sorts, analogical and internal. The former is

derived from observation of other cosmical bodies; the latter, from a study of the earth itself. At present they appear limited. Hereafter they will be numerous, both astronomical and mathematical, and completely demonstrative.

The analogical evidence is derived from comets. Their varying dimensions, as they approach and recede from their perihelia, demonstrate a remarkable solar influence over the mobility of the molecules composing this class of bodies. When freed from the grasping power of the sun, which is exerted with so much energy that we fear they must be swallowed up in its atmosphere, they dart away as if rejoicing in their freedom, and expand as they recede; the nuclei yielding up their centralizing forces, and the condensed matter of the whole mass returning to what appears to be an original equilibrium state of expansibility. This element in the physical

constitution of some comets, being well observed and substantiated, makes it certain that a similar law presides over the structure of all; though difference in distance, external relations, or internal composition, might not render telescopic observation uniformly positive.

Now, if one class of revolving spheres, whose physical structure is known to possess great molecular mobility, be subject to such remarkable expansions and contractions of their molecular relations, by the mutual play of their own and the solar forces, why are not other revolving spheres, of greater density and possessing equally potent central forces, subject to similar alternations of size? alternations, however, which, in consequence of their solidity and peculiar atomic forces, may not be so sensible to optical observation? There is no reason why this should not be so.

To say nothing of the fluid condition of

the interior, all observation shows an extraordinary degree of mobility in the particles composing even the solid rocks of this globe. Mountain masses of stratified granular limestone are changed into the most beautiful crystalline marbles, simply by the injection of molten lava through their strata. This change is effected solely by calorific radiation. Here is an alteration in the absolute juxtaposition of molecules, so great that the whole mass has changed its character and its physical appearance. But we have another sort of evidence, too sensible to be mistaken, of the mobility and expansibility of the matter of the solid crust of the globe. The trundling of wagons over pavements or frozen ground communicates oscillations of the surface for some distance. Explosions of gunpowder are still more remarkable for their oscillating action on large extents of ground. But the evidence of

greatest value in this connection is derived from earthquakes. The force in these phenomena acts, indeed, from within the earth impulsively and spasmodically; but the result, if sudden and violent, is still the same on the mobility of terrestrial molecules. Vast extents of the globe sometimes feel the oscillation communicated by these subterranean forces. That of 1755, which concentrated its violence under Portugal, produced a radiating oscillation of molecules over the whole Atlantic mass of the earth and ocean, the whole of continental Europe, and the northern part of Africa. All these prodigious results are produced by the impulsive action of one molecule against another, until the whole hemisphere has felt the impulse given to the first molecule by the subterranean force.

If, then, physical causes, under common observation, produce such sensible and

extraordinary effects on the earth, why may not the powerful radial forces of the sun, so universal in their action as to be felt in every molecule of a revolving globe (and those antagonistic energies exerted by that globe through every molecule of its mass),—why may not the insensible, but active and positive, exercise of these central forces exert an effect equally insensible, active, and positive, in producing alternate expansions and contractions of the whole globe, as it recedes from, and draws within, solar influence? These forces radiate from centre to circumference, and are exerted from molecule to molecule. These oscillate as the forces play upon them, and recede or press toward each other from centre to periphery, according to the direction of the earth's motion, and its distance from the solar orb. The great repulsive power of the sun is exhibited when the earth is in perihelion, by preventing its

closer proximity to that body. The great repulsive power of the earth is exhibited to us sensibly by the enlargement of the moon's orbit. This increases as the earth approaches the sun, and is largest when the earth is nearest to the central body. Astronomers have attributed the enlargement of the lunar orbit, as the earth approaches the sun, entirely to the sun's attraction of the moon away from the earth. May not this be an error, growing out of imperfect knowledge of universal laws? May not the varying dimensions of the lunar orbit depend in a great measure upon the degree of terrestrial repulsion? That repulsion is greatest when the earth is in perihelion; and it corresponds to a similar maximum solar force, and both are necessary to sustain the equilibrium of the system. This force pervades cosmical spheres through their molecules. It is a secret, potent, all-pervading influence. It

appears to act upon the molecules of celestial masses like extreme pressure applied to masses under human control. Condensation, and consequent contraction, must be necessary effects of the stupendous compressive or repulsive energy exerted upon a body, when it is forced into such proximity to the sun as to be wholly incompatible with an equipoised display of its central powers. In comets so sensible to the controlling influence of solar energy, the phenomena of alternate condensation and expansion, according to their nearness to the central body, are demonstrated to the eye. The material structure of the earth is exceedingly dense; but we must, nevertheless, conclude that the physical changes in it, resulting from the action of the solar forces, must be similar to and as determinate, though not visible to the eye, as those observed in more rare and translucent spheres.

The second class of evidence, which I shall bring to sustain my proposition, is internal; and that, of course, is strictly geological in its character. At first thought, it would seem as if no testimony from this quarter could bear upon the question; but the earth is a celestial sphere, like other planets, and as such must be obedient, throughout its whole molecular structure, to universal laws. This class of evidence embraces three distinct orders of phenomena, all of which are well observed; but their causes heretofore have been involved in the deepest obscurity.

I. Geological investigations manifestly declare that the surface of this globe was at some time, and perhaps at many different times, wholly enveloped by the ocean. It is probable that, in the morning of its creation, it was in this state; wholly surrounded with an envelop of water and another of air, neither of which was disturbed by

such prodigious encroachments of solid matter as now destroy their conformity.

Geological observations also show, that elevations and depressions of vast areas of the earth's surface have taken place at various ages, and that these changes of elevation cannot have been spasmodic and rapid; but that they were quiet and gradual, occupying incalculable periods of time for their accomplishment. Volcanic agencies produce local elevations and depressions, more or less suddenly. Islands and mountains may be suddenly formed or suddenly sunk. The vent of volcanoes may affect comparatively small regions of surface in their vicinity, so that they may gradually rise or subside during the quiescence or activity of such volcanoes. But the slow and insensible submerging or elevation of vast continents, so gradual that an inch or a foot during a century will only gauge the gain or loss of the ocean,

cannot be accounted for by ordinary volcanic agencies. Forces acting from the central foundations of the planet, slowly, quietly, insensibly, as the march of time, — as insensibly, as gradually, as steadily, as the periodical expansion and contraction of the whole terrestrial ball itself, — will alone explain these extraordinary changes. These elevations and depressions are positive and unmistakable. They have been alternate and numerous. They have extended throughout all geological periods. They mark ages of such incalculable length, that the mind is bewildered in its attempts to study the antiquity of their beginnings.

At the present time, the whole north of Europe, and Greenland, and the continent of South America, are slowly rising above the sea; and the bed of the South Pacific ocean is sinking deeper below the surface. I formed a similar opinion of the bed of the Indian Ocean in 1844, during my explora-

tion of the Island of St. Paul's, which contains an extinct and partially submerged crater. The nature of the soil and appearance of the rocks indicated an immense antiquity; and my impressions, as I contemplated its solitary position and its structure, were, that it was only a tombstone marking the burial-place of a continent, long since engulfed beneath that vast sea. The character of the soundings several miles distant from the island, and the color of the ocean observed while sailing two days in a south-easterly direction from it, confirmed this impression. Observations of travellers on the coral formations in the northern parts of the same ocean have established this opinion as a geological fact.

This ponderous uprising and subsidence of whole hemispheres of the solid earth cannot be accounted for by the ordinary operation of volcanic causes. The agency

is deeper and more pervading. It operates more steadily, firmly, powerfully, and universally. How prodigious must be the forces requisite to lift whole continents, so slowly and steadily! How uniformly and uninterruptedly must these forces act to sustain them, and to let them fall again so quietly and insensibly towards the centre of the globe! Where shall we search for agencies short of the fundamental organic powers which operate on the whole mass of the planet through the individual motion of its molecules? Nothing short of the action of stupendous radial forces can produce such gigantic geological phenomena.

How do these forces act to produce such extraordinary results?

The theory of central heat is not new. The common phenomena of hot springs and volcanic eruptions, and recent observations of the increase of temperature the deeper we descend beneath the surface, has

nearly decided the opinion of scientific men on this question.

The theory of the chemical creation of the earth here presented exhibits, in the beginning, such an amount of voltaic action, that the whole interior of the globe must necessarily be subjected to the highest degree of incandescence. The present and remotest time equally sustain this theory by the numerous exhibitions of molten matter which have been poured out from the interior of the globe, through fissures in its crust. Some philosophers have made numerical calculations on the excessive degree of heat which must appertain to the molten mass of the central parts of the globe. It is only necessary for my argument to mention this fact, when the extreme degree of fluidity of the molten matter will be at once comprehended. This condition of it would greatly facilitate the mobility of its molecules.

Now, suppose the terrestrial sphere started on its course, for the sun, from that region of space where it received its creation. It would fly on, drawn by the accelerating power of the solar centre, condensing as it flew; and at last it would reach that point of its rectilinear course, when the individual repulsion of its molecules would assume an active and positive radial force, create enormous tension, and begin to exhibit itself as a planetary power. Now, its own repulsion, or the sun's, or both united, would compel it to change the direction of its motion, and to assume a curvilinear course. Here its orbit would commence its birth, and the planet would continue to advance with accumulating velocity. Advancing motion would be accompanied by a corresponding accumulation of molecules towards the centre, an absolute contraction in volume, and an equal increase of internal tension and molecular

repulsion. Having reached the perihelion, its contraction, and the intensity of its accumulated forces of atomic and planetary reaction and repulsion, would be greatest. Passing this point, the terrestrial mass would begin to be relieved from the complex influence of forces which had constrained the relations of its molecules like external pressure; and it would recede from the sun, gradually regaining its atomic equilibrium, and expanding in all its radial dimensions.

The greatest degree of repulsive action exerted between its molecules and masses must take place when the earth is contracting its volume, and during its advance towards, and while in the more immediate neighborhood of, the sun. At the time when it approached so near to the central body as to be deflected into an elliptical orbit, it must have attained that degree of tension, which alone was compatible with

its molecular equilibrium. A forcible advancement beyond this point would necessarily destroy that equilibrium, and incite an increasing intensity in all its repulsive forces, and a radial reflex action, so strong in various directions, and at different times, as to create distension of the semi-fluid surface, or fissures in the hardened crust, attended with outpourings of molten matter. Thus, as the earth is approaching, and nearest to, the sun, its internal tension is so great that it is ready, at any moment, to burst its crust, and to give vent to its confined currents of molten fluid, in the thinnest and weakest parts of its surface. Any pointing, whether produced by cracking or quiet elevation of the surface, would form a sort of focus, exposed subsequently to a more intense action of internal radial force. Whatever the amount of elevation of solid matter, the depth of the ocean over that part would be diminished, and its

volume would be augmented over other parts of the earth. Great irregularities of surface having been induced, difference in gravity of the undulating parts would aid to increase the irregularity. Atmospheric and hydrostatic pressure would diminish on the rising surface, while it would increase to a corresponding degree on the subsiding parts. The radial reaction of the internal fluid mass would act the most energetically where it encountered the least resistance. And thus, in the course of countless revolutions of the earth, the periodical expansion and contraction of the globe would bring about the slow and gigantic changes of elevation and depression which are at present transpiring, and which can be traced through various geological periods.

The upheaving and subsidence of hemispheres are effected so slowly, that the changes can be discovered only by the pa-

tient observation of centuries. However slow and imperceptible, these changes are positive ; and the agency producing them is quiet, uniform, irresistible, and universal. The motion of the interior fluids, which alone can create and sustain these slow and vast revolutions of the surface, must be connected with, and controlled by, the supreme forces which chain the earth to the central body. What other agency can produce them ? What but an agency like this could have produced that wonderful chain of American elevations, extending from the arctic to the antarctic circles ? The expansive power of the compressed and reacting fluid was such as to rend asunder one entire side of the globe, project the hardened crust, and here and there obtain vent for itself through fissures opened to the surface. Here the pointing was irregularly linear, and extending almost from pole to pole ; and the result of that

first impulsive movement has been the slow and gradual upheaving of the whole American continent, and a corresponding subsidence of the bed of the Pacific Ocean.

II. Another order of effects, of a geological but comparatively isolated character, presents itself to substantiate the view set forth in this inquiry. These are volcanic phenomena. Though isolated, they are numerous, and must form an array of evidence, taken in the aggregate, decidedly favorable or unfavorable to any hypothesis relating to the revolutions of the earth's surface. They are connected with the motion of the fluid mass of the interior of the globe. Earthquakes and volcanic eruptions manifest themselves in various quarters of the earth. No region of the surface of this vast sphere, so far as we know, has been or is exempt from exhibitions of these phenomena. Being universal, their cause must be equally so. If the accumulated

tension of the fluids of the inner parts of the planet exist by special relation of its distance from the sun, we must expect to find a greater number of volcanic phenomena occurring during the earth's repulsive condition, or when it is approaching the sun, and while occupying the parts of its orbit nearest the solar focus. What are the facts on this point? So far as scientific statistics have been accumulated, it is ascertained that the greatest number of earthquakes occur in the months of December and January. Mr. Robert Mallet, who presented a report on the "Facts of earthquake phenomena" to the British Association, held in Ipswich July 2, 1851, made this statement after the computations of a catalogue of earthquakes amounting to nearly six thousand, and extending from remotest observations to the date of his report. The report is made with remarkable scientific exactness, and was designed

to sustain a special theory of his own. The evidence furnished to this inquiry is incidental, and therefore of the greater value. The catalogue I have not seen; but, from the studious care for scientific accuracy exhibited by the author in the details of his observations, I have great confidence in its fidelity; and a special analysis of it, in reference to this great question, would probably do much towards its elucidation.

The western part of South America is a volcanic focus; and the frequency of earthquakes in those regions is so great, that they may furnish some evidence on this important subject. A writer in "Blackwood's Magazine" for July, 1846, makes this statement, drawn probably from Dr. Tschudi's Travels in Persia, as well as from other sources: "At Lima, earthquakes frequently occur. On an average of years, five and forty shocks are annually felt, most of which occur in the latter half

of October, in November, December, and January, and in May and June. January is the worst month; during which, in many years, scarcely a day passes without convulsions of this kind."

These facts are certainly extraordinary; and the report of Mr. Mallet to the British Association was so striking in this particular, that "Mr. Hopkins remarked, that, while he placed no faith in such indications as those of earthquakes being *more frequent in winter, they were yet very curious*, and it was not yet known how much might be due to the influence of apparently trivial causes."

The *causes* which produce these remarkable periodical exacerbations of internal force are by no means trivial or accidental. They coincide with the periodicity of the earth's more intimate relation with the sun; they coincide with the period when the tension and molecular repulsive action

of the interior of the globe is greatest; and it must be clear to all minds, if the crust of the earth be so weak in certain parts as not to sustain the radial repulsive action of its fluid interior, — which is exerted with irresistible power to elevate entire continents, — that it must be rent asunder, and the molten currents be injected into fissures, or between strata, dislodging them in various directions, and thereby convulsing the solid ground. These manifestations of internal repulsive forces are *earthquakes*; and, though the chemical and galvanic changes going on within the globe may be such as to produce isolated phenomena of a similar kind, still the increasing tension of the planet as it approaches the sun, and the continuance of that tension while it is nearest the central body, would give efficiency to local agencies, and render earthquakes and volcanic eruptions more frequent from July to

February or March, than during the other months of the year. Facts, so far as my own researches extend, sustain the views which are presented; and I desire to invite the attention of travellers and scientific persons to this announcement, with the hope that rigid observations and inquiries may be instituted, which may determine the truth of this interesting question.

To strengthen the weight of the evidence derived from volcanic phenomena, and which bears on the question of the earth's contraction during its advance, and the augmented radial pressure of its molten interior on its crust, while in those parts of its orbit nearest to the sun,—it is desirable to ascertain if these local exhibitions of internal force occur simultaneously in regions far distant from each other. My own memoranda are limited, having been commenced in August, 1852. But it is very remarkable, so far, that

subterranean violence should have been exhibited on three different occasions simultaneously, in parts of the planet remote from one another.

The first was on the 20th of August, when Mount Etna assumed intense activity, accompanied by an earthquake and an immense flow of lava. On the same day, Cuba was shaken by an awful earthquake, Santiago was partially destroyed, and eruptions of lava broke out on the island. This circumstance is very remarkable, and should stimulate scientific mind to great activity in its investigation of the causes of these events.

The second coincidence of volcanic phenomena, in regions remote from each other, occurred on the 10th of October, when Luzon was visited by a terrific earthquake; and, on the same day, two distinct earthquake shocks were felt at Clinton, Georgia.

The third occurred on the 26th of November, when Cuba was again convulsed with great intensity; and a distinct, but not violent, earthquake shock was felt in the northern part of Massachusetts, and the southern part of New Hampshire.

Besides these coincidences, the outpourings of Etna have been continuous, from the 20th of August into the month of December; and, in the meantime, earthquakes of greater or less violence have occurred, at longer or shorter intervals, and sometimes almost simultaneously, in Luzon, Chili, Peru, Mexico, California, New Hampshire, Virginia, Georgia, Texas, the West India Islands, north of England and Ireland, south of Spain, Teneriffe, north of Hungary, and in China. It is very probable that others have convulsed the beds of the oceans, or the interior of Africa or Asia, of which we have no accounts.

These facts all point to a similarity of internal pressure on the crust of the globe; and transpiring remotely from each other, at the same time, or at short intervals, they indicate a universal action radiating from the centre to the circumference of the sphere; and they thus strengthen the weight of the argument herein presented.

The evidence of Mr. Mallet's catalogue must furnish important data in this connection. As the remarks in his report, however, are only incidental, they are not so full as I could wish; but future analysis will make his records of great value in this branch of inquiry. The general result of his analysis is, that "coincident earthquakes in time at distant places on the earth's surface have been by no means rare, as at Iceland and Norway, Poland and Constantinople, &c." For further facts of this sort, he refers to his catalogue. With

regard to one coincidence which seemed to have a doubtful bearing on his own views of the transmission of the earthquake wave, he says, "There is some ground for believing that one and the same shock of earthquake was felt on November 16th, 1827, at places nearly antipodal, viz. at Ochotsk and at Columbia in South America; and, if so, had its origin not very remote from the centre of the earth."

The fact that violent earthquakes occur when the earth is receding from the sun, and its whole molecular structure is dilating in volume, does not invalidate the force of the argument founded on their greater uniform average, during the earth's approach and its passage through the parts of its orbit nearest to the central body. It would only demonstrate the uninterrupted activity of the radial forces, and the extreme tension of the molten currents of the interior of the globe. Besides, constant

changes in the arrangement of the molecules must favor developments of chemical and galvanic forces of a gigantic character, and abnormal causes would be very likely to produce untimely events. This sort of agencies would be local and spasmodic, and scarcely tend to disturb, for a moment, the uniformity of the slow and universal causes of elevation and depression of the hemispheres which are exerted virtually through the radii of the entire planet.

It is more than probable that certain untimely occurrences, alluded to above, and the irregular periodicity which have been observed in volcanic and earthquake phenomena in different regions of the globe, may be connected with the conjunctions occurring at various intervals between the earth and the internal and external planets. From its close relation to the earth, and its periodical nearness to the sun and to the planet Venus, we should naturally expect

that the moon would be subject to that sort of radial molecular action which would make it peculiarly the seat of intense volcanic forces. It is a remarkable fact that telescopic scrutiny demonstrates this to be unmistakably the case. Even as long ago as 1787, in the month of April, — a period when the satellite is drawing near to the earth, — Sir William Herschel discovered three burning mountains in the moon, and observed their changing aspects for several nights. The vast crater mountains and enormous ravines and fissures which mark the surface of its visible hemisphere, all indicate the most violent radial energies to have been exerted within it during past time. The opinions of selenographers are uniform in declaring its surface to be infinitely more broken and irregular than the surface of our own globe. The nature of the forces, both distant and present, which have produced these similar superficial

irregularities, must be identical ; and if the doctrine set forth in this treatise be true, it will appear — to say nothing of the absence of aqueous and atmospheric envelops — that the moon will not for a long period, perhaps never, become habitable to the higher orders of organic life.

There can be no doubt of identity between the craters, lava currents, and other volcanic aspects of the moon, and of similar conditions, both recent and ancient, of the earth's surface. The largest and deepest extinct crater on our globe is probably that of Hale-e-ka-la (in Polynesian dialect, "the house of the sun"), on the Island of Maui, which I have examined several times with intense interest. Though ten thousand feet high, — and observed from a distance appearing like a beautiful dome, — with an abrupt crater 2500 feet deep, and perhaps twenty-five miles in circumference, presenting sixteen small craters from two

to eight hundred feet in height, rising from its pent-up floor of black, rough, and glistening lava, it is still a mere pigmy in comparison with Bailly, Clavius, Schikard, and many other lunar craters. The resemblance between the aspects of the great crater mountains of the moon and of Hale-e-ka-la in the Hawaiian Islands, and of Malinché and the numerous isolated volcanic cones of vast dimensions which I have observed in Mexico, has filled me with such amazement, that, when examining the moon, I have almost imagined it to be a part of our own planet. All observing travellers who have visited volcanic regions of the earth, and then surveyed the moon through suitable telescopes, must have been impressed in the same forcible manner. Like causes, under the same circumstances, beget like results; and so we find the volcanic upheavals of the moon's surface exhibiting proof of the strongest kind to

sustain the general law of molecular expansion and contraction of all revolving spheres, as the special results of their relation to central bodies.

III. Besides the geological changes arising from the sensible action of the dense molten ocean which fills the interior of the globe, there is an order of appearances in its solid crust, which presents strong evidence to the point, that the earth is undergoing alternate contractions and expansions of its entire volume. They appear to be universal effects of molecular motion in the solid matter, and of a steady and quiet pressure, — the result of internal tension on the crystalline crust of the planet, — in contradistinction to the local and circumscribed action of violent and spasmodic outbreaks, occasioned by igneous ulcerations, or weakness of the surface. This class of appearances embraces the fissures, cleavages, splits, and heaves, so well

known to miners, and mostly occurring in directions north-south and east-west throughout the entire globe, from its surface to the greatest depths explored by man. There is much reason to believe, that a careful study of many dislocations of strata, heretofore supposed to have been produced by sudden and spasmodic upheavings, will prove them to have resulted from the quiet, gradual, and long-continued action of a radial repulsive force. These fissures or splits in the crust, of great depth and extent, are sometimes observed to take place in mines unaccompanied by earthquakes, or sensible subterranean convulsions. They are sometimes so sudden as to create alarm among the miners, and so extensive that the solid crystalline structure of the crust will open several hundred feet, and in some places a number of inches in width. Sudden concussions and internal sounds are frequently heard in the mines

of all countries; and the sides of veins often bulge out in such a manner, that all mechanical resistance to their movement is without avail. What is very extraordinary, these circumstances transpire without sensible agitation of the earth. Noises, evidently, from their varying sounds, the result of cracking of the crystalline rock, have been heard on the surface of the earth in various countries, when they were not heard in mines many hundred feet below. The contrary of this has also been observed; and noises, unattended with earthquake movements, have been heard in mines, so as to alarm their occupants, when on the surface nothing of the kind has been heard.

These are very interesting phenomena considered in this connection; and their cause, as universal as their extent, may be traced directly to the molecular disturbance of the solid crust, and to the alternating

change of volume which is constantly going on throughout the entire solid and fluid contents of the globe.

Such is the internal or geognostic evidence, that the globe expands and contracts periodically, and in direct relation to its distance from the central body. These alternate changes produce the vast irregularities of its surface, either slowly when operating under immense areas, or actively when local circumstances may increase the intensity of the universal force on some particular part of the crust.

These two classes of evidence being tenable respecting the earth, we must conclude that all other planets will sustain the same relations to the sun, and be affected physically in the same manner.

Similar inequalities of surface would be produced by similar causes; and thus we find the moon and various planets, as far

as telescopic observation can reach, to have undergone the same physical changes which are still progressing upon this planet. How central and radiating, then, must be the universal cause of molecular motion in the planetary masses, when the results are so uniform throughout the system! Such causes must be exerted by the great central controlling force, and that force is embodied in the sun. It embraces all revolving spheres in its far-reaching influence, acting silently and powerfully through their molecular structure, and stimulating their internal forces to exhibitions of phenomena, too wonderful and multifarious to be easily understood by man.

Need further evidence or reasoning be adduced to sustain the proposition which has been laid down? It is promulgated as a universal physical fact, growing out of the great fundamental laws of cosmical attraction and repulsion; and I must leave

all my deductions to be sustained or overthrown by the results of future investigations.

The existence of a force antagonistical to that of gravitation has seemed to me as necessary for the stability of the universe as that of gravitation itself. The action of the two forces would create the compound motion requisite for the constitution and maintenance of the planetary orbits. The present doctrine of centrifugal force, applied to the motion of the revolving orbs, embraces a negative and lifeless idea. The term "tangential force" is perhaps considered by some as more significantly expressive of an unknown power acting upon an inert sphere; but whence the origin of that power? In the beginning, all matter sought the great central focus, and would have reached it, had it not been repelled. Molecular attraction and repul-

sion are but the diminutives of the vast energies which sustain worlds and suns at fixed distances from each other. Planets are like atoms floating in boundless space, whose relations are definite and eternal; and they can neither approach nor recede beyond the limits of laws which bind them to the great central body. Laws governing atoms act in complete harmony with laws controlling spheres. When planets are in aphelion, it would appear as if their molecules are at greater, though still insensible, distances from each other, and more in equilibrium, than when in other parts of their orbit. When they begin to press toward the sun, their molecules sympathize with the solar power, and begin to press toward each other. As the intensity of solar gravitation increases, a corresponding activity of molecular condensation takes place in the advancing sphere; and this increases until the perihelion is reached.

Here molecules and orbs alike have attained their greatest degree of juxtaposition, and they exchange forces. Beyond the perihelion the sun yields its attraction, and the molecules of the sphere recede from each other in proportion as the sphere recedes from the sun; and they continue to seek that degree of equilibrium which they possessed in aphelion, where solar influence is at its minimum. In this solar action on the vast planetary masses, we see but the counterpart exhibited in the forces which play between molecules. The physical results of this law of mutual relation is demonstrated to the eye in the translucent spheres of comets; it is exhibited by various sensible phenomena on this earth; and, by optical aid, we behold in other planets the same stupendous cosmographic changes which molecular mobility, superinduced by solar influence, has effected in our own globe. Thus does

the entire material universe harmonize throughout its frame. In the minutest monad and the mightiest sphere, we witness the operation of kindred forces; and, while one rotates in microscopic epicycles to fulfil the destinies of its creation, the other rolls in majestic circuits through immensity of space, to accomplish, with equally wonderful precision and harmony, the mysterious plan of its being.

In reviewing this broad and interesting field of research, two prominent ideas are presented forcibly to the mind, relative to the state of human knowledge. We are surprised at the immense accumulations of exact learning, and at the progress of scientific discovery, since the days of Copernicus; and we are impressed with the magnitude of the experimental and contemplative labor to be performed during succeeding ages, to connect, by inductive

science, present and known forms and forces with the forms and forces of the distant realms of space, and to dispel the mysteries which enshroud the manifold works of the Creator. The more profound and exact the inquiry, the greater is the simplicity discovered in the nature of physical laws, and in the methods of their operation. This has uniformly been the result of all sound generalization; and the multiplied forms of physical force and material being, heretofore wrapt in obscurity, or exhibiting great complexity, are resolving themselves, one by one, into the most beautiful unity and order, under the brilliant light of modern discovery. Even the views exposed here for the first time to the consideration of scientific men, that this earth and all planets undergo periodical changes of volume, and variations, both in character and in intensity, of their internal and external radial forces, and that a cosmical radial

repulsive power is generated during their molecular condensation, are rendered the more probable by recent experiments of Faraday, Plücker, and Matteucci, on various forms of matter. They have discovered that the magnetic property of all substances has its attractive force diminished materially by heat; and that the diamagnetic property loses scarcely any of its repulsive power by the same cause. Iron, for instance, which exhibits a maximum of attractive force, has that force diminished fifteen million times by fusion; while bismuth, which exhibits a maximum diamagnetic force, suffers by fusion a very slight loss of its repulsive power. Professor Matteucci, by most carefully conducted experiments, has established the fact, that mechanical pressure, applied to diamagnetic substances, increases their repulsive force very sensibly, according to the decrease of their volume and the increase of

their density. This is a remarkable fact; and, though a mere experiment, it demonstrates the inherent and wonderful forces of matter; and, if the mass submitted to experiment be augmented in volume, and a corresponding degree of compression applied, the exhibition of forces generated will be proportionally great. This earth being a compound of matter possessed of paramagnetic and diamagnetic, attractive and repulsive properties, it would probably be influenced under natural, as small amounts of matter would be under artificial, circumstances. If the contraction of the planet should be accompanied by increased accumulations of internal heat, as is very probable, its attraction as a planetary power would be progressively diminished; and, if its condensation was accompanied by an increased repulsive power, that power would be exerted as a planetary influence, and hold the revolv-

ing sphere at definite distances from the central body. A universal magnetic condition of the earth has been ascertained to exist, when formerly it was only suspected, on account of the correspondence of electrical experiments with certain terrestrial phenomena. It remains now for science to demonstrate clearly a diamagnetic condition of the globe, and to establish the existence of paramagnetism and diamagnetism, or of two similar universal and opposite principles, as organic agents, lying at the foundation of all cosmical creations, reigning over their atomic structure and sidereal relations by reciprocal influences, and consolidating the resplendent framework of the universe, to whose boundaries human sight or knowledge can never extend.

The pursuit of this inquiry has led to the development of a sublime and beautiful

truth, uniting inseparably the two great departments of astronomical and geological science. Heretofore they have been as widely separated as the heavens and the earth. Astronomers, so charmed with the glories of the celestial universe, have hardly devoted an hour to contemplations of the physical structure of our own planet. Geologists, so amazed at the countless vestiges of animal life which crowd the strata of the earth's crust, barely glance at the heavenly bodies, and theorize only on the results of Plutonic agencies, or aqueous and atmospheric degradations, and on the destruction of antediluvian races. Science and philosophy must awaken to still more sublime contemplations. The earth is only one marvellous link in an endless chain of cosmical creations. It is composed of atoms, each one of which is bound by mysterious and harmonious relations to all the rest in the physical universe. The

revolutions of the earth around the sun not only expose its surface to cheering and fertilizing beams of light, but its universal mass throbs through every molecule, as it hastens along its circuit in obedience to the great celestial laws. It is moved from centre to circumference with intense activity. Quiet and gigantic internal changes beget quiet and gigantic external results. Slow igneous ulcerations of the inner surface of the crust at last induce sudden subterranean convulsions, or volcanic inundations. Universal or local revolutions of surface ensue. As continents rise and oceans retire, isothermal variations as gradually succeed each other; and, in corresponding succession, various organic creations spring up, or pass away, both on the earth and in the sea, according to laws regulating their physical inception and development, ordained by the Almighty.

Thus is evanescent, ever-changing life

upon the earth connected with the ceaseless rolling of the spheres. While the varying seasons, and day and night, are necessary for the resuscitation of natural forces, and the differing wants of organic being, the revolutions of the earth's surface are necessary for unfolding the endless resources of the Creator's plan, and to prepare it for the abode of the crowning work of his will. Epochs, whose duration exceeds all human calculation, have succeeded each other in unknown numbers, with all their multifarious forms of existence rising progressively in the scale of development with the lapse of time. Strata on strata of organic remains have thus been heaped together in the sea and upon the land; and, were the deposits of each geological age piled one upon the other, they would rise many miles in height. Had complete repose brooded for ever over the globe, granites, slates, marbles, coal-beds,

and metalliferous mines would all lie deep in the bowels of the earth, or beneath the ocean, and beyond the reach of man. But the ever-changing year, which brings seed-time and harvest, and summer and winter, for the growth and sustenance of swarming myriads of organized forms, brings at the same time changes in the physical constitution of the planets, slow and imperceptible, or active and determinate, which exhibit with overwhelming eloquence the beneficence and universal providence of the Creator. How necessary all these changes for the highest physical happiness and the intellectual and moral perfection of man! Had our race been created first instead of last, the bare granitic surface of the globe would have been an inhospitable abode indeed; or, midway in the course of ages, we should have inhabited a surface filled with a rank and noisome vegetation, exhaling only pestilence, and unfit for the

fulfilment of the sublime plan of our creation ; if still later, our companions would have been hideous and terrible monsters, whose existence would seem fabulous, did not their remains demonstrate to us their magnitude and rapacity. But the lot of man was designed for the highly elaborated surface of the earth, where the companions of his creation could administer to his wants, and aid his occupations ; and where all the abounding wealth of metals and of decomposed animal and vegetable remains has been overturned and exposed by physical changes, to invite and reward his mechanical and agricultural toil.

Thus all created things seem linked together. We can trace the special creations of God from step to step on this globe, all the way from man back to the first plants and animals which he made in the primordial seas. Special and definite interpositions of divine thought and energy are

manifest from age to age in organic creations, and they are all linked to the successive revolutions of the surface of the earth. Through countless ages we can trace these changes, and these exhibitions of Infinite Wisdom, till we arrive back, and stand upon the bare crystalline surface of the uninhabitable globe. The contemplation of these changes and these creations almost brings us face to face with the great Jehovah. How wonderful and manifold his works! How marvellous the faculties of thought which translate us towards Infinity! But the cause of these remarkable changes in the planet, to which vegetable and animal life are subordinate, lie without and beyond it. The influence which steals through its constituent molecules is more subtle and potent than the light and heat of the solar rays which warm and fertilize its surface. In these solar powers dwell the levers of the Almighty, by which he

has raised from the bosom of the deep the lofty mountain and sloping vale, and prepared them for the abode of successive races of plants and animals.

Thus, by the exertion of the intellectual and meditative faculties with which man is endowed, he can ascend step by step through the infinite series of created things; behold his own existence linked through the atoms of the earth to the heart of the sun, — and that depending for its energies and stability upon the stellar multitudes of the milky way; and the whole universe chained together in one vast empire, embracing alike molecule and globe, sun and systems of suns, stretching beyond the reach of mortal sight, and all bound with enduring power to the omnipotent arm of their Creator.

THE END.

ERRATUM.

For "Persia," p. 143, line 18, read "Peru."

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