CURSORY THOUGHTS

ON SOME

NATURAL PHENOMENA;

BEARING CHIEFLY ON THE PRIMARY CAUSE

OF THE

SUCCESSION OF NEW SPECIES,

AND ON

THE UNITY OF FORCE.

"In contemplation of created things,
By steps we may ascend to God."
MILTON.

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CHARLES SCRIBNER, 124 GRAND STREET.
CHARLES B. RICHARDSON, 264 CANAL STREET.

CURSORY THOUGHTS,

ETC.

I.—On the Movements of the Orbs in the Solar System.—A New Chart proposed.

II.—The influence of those movements on the Development of Mundane phenomena. Origin of species, &c.

III.—Attraction the Parent of all Forces—Repulsion springs from it.

I.

As there are no absolute duplicates of mental any more than of material organisms, men can no more think alike in every minutia, than look alike. Every individual contemplates a subject under impressions somewhat peculiar to himself, hence shades of difference abound when general uniformity prevails. This remarkable trait in the plan of Creation is essential to individuality, to social existence, and to progress, for if varieties of intellectual did not equal those of physical conformation much of nature's operations would escape detection; hence the saying, that every reflecting person however humble his parts may contribute some one hint or other to the common stock;—that, however often reapers may pass over the fields of knowledge, there will always be something for gleaners to pick up;—that, as with matter, every modification of mind, the lowest as well as the highest, is not made without a purpose.

STUDENTS of nature know, that every form, color, quality and condition of matter is replete with instruction, and that the knowledge of it can never be exhausted. It is the same with motion and every variety of motion. Human ingenuity has contrived a multiplicity of mechanical movements, but, as with every discovery in the arts, they have their natural prototypes on the earth or in the heavens.

The lines described in space by the orbs that compose our system have not, that I am aware of, been portrayed, and yet, it is not too much to say, their varieties, their convolutions and circumvolutions, their mathematical accuracy, their harmony and their beauty, present materials for a chart or a series of charts, as interesting and instructive as any that have employed the hands of engravers, or put in requisition eccentric or geometrical lathes.

The ordinary tame diagrams of the planets, arranged in simple concentric circles, with the sun in the center, might do well enough if they impressed ordinary readers or popular audiences with the actual facts. If the sun were stationary they would do this, but as he is ever advancing through space, they do not show how a planet, the earth, for example, gets out of one circle into another to keep up with him. It is the same with the satellites. Our moon follows the earth to circulate round her, as she follows the sun to circulate round him.

I would therefore have both orbital and axial movements projected; not by plane lines but by such as accord with central and surface movements. What these are like, would be seen if every planet had marking styles that left tracings behind them. We should then behold systems of curves running into figures allied to the engine work on watch-cases and vignettes on bank bills, and surpassing them—the best of them—in symmetry and precision. Though closed to material they are open to mental vision, and afford glimpses, in the grandest of material movements, of the glories of the invisible works of Creation.

If the earth did not turn on her axis, the lines described by every part of her surface would be similar to that of her axis, but, as she turns round it every twenty-four hours, her equator describes a series of 365 circles in each revolution

round the sun; hence her orbital path is made up of these instead of a single one, and these are multiplied indefinitely by points on the equator—interlocking each other more or less closely, according to the distance between the points.

Again, marking pencils ranging from her equator to the poles would exhibit the phenomenon of the equatorial circles resolved, through cycloidal or epicycloidal curves, or whatever their proper names may be, into straight lines and even into points. The interlocked circles gradually separating, then flattening into cusped figures, next into deep, and then into shallow undulating lines, which finally approach straight ones, and those ending at each pole in a point.

With the earth's orbit of circles another set of lines is combined—those described by the moon. The period of her rotation is exactly equal to that of her sidereal sweep round the earth, hence she rolls round us twelve times in the year. She therefore contributes a series of waving lines that cross and recross the circles described by the earth. The lines followed by the centers of the earth and her satellite should also be given in the pictorial representation.

Though mentioned as circles, the orbits of both planets and moons are elliptical. That of our moon has of course the earth in one of its foci, and the ellipse is constantly changing its form and position on the plane of the earth's orbit. It is obvious that no body can move round another in a circle while the center of that circle keeps going forward.—Hence elliptical orbits would seem proofs of progression of central bodies; and may not their progression be deduced from the ellipticity of their orbits or of their secondaries.

As every planet, planetoid, and moon differs more or less from the rest in the character and intersections of its curves, a chart representing the whole, or chief of them, in their order and proportion, with the cycloidal like lines of the rotating sun in their midst, and the extremes of elliptical lines brought in from various directions by the comets, would be of general, enduring, and increasing interest. To ordinary minds a glance would give pleasure, while to the studious it would be suggestive of sublime contemplations.

If the lines in a representation of the whole system should be too much involved for an ordinary sized plate, let us have

it in sections, or sub-systems, as those of Jupiter and Saturn, either of which would be an acquisition.

II.

Of the utility of such a map let no one doubt, or for a moment imagine its value would consist chiefly in pleasing the eye. As well suppose nothing interesting in flowers but their colors, or in birds but their plumage. To attain just conceptions of mundane marvels it is necessary to refer to transmundane movements: Sublime in the highest degree, and simple as sublime, all others are not only comprised within, but have proceeded from and are governed by them. As the whirring mechanisms of a factory stop the instant the propelling power is cut off, so would motion in all terrestrial organisms be arrested by the cessation of celestial movements.

Hence as there is no property of matter here, so there is no motion in this part of the heavens at least, but what has a direct bearing on the progress of our species. For this the power to discover them is given. Astronomical diagrams have made clear to all comprehensions the relationship of this earth to others in its vicinity—that we are occupants of one of a number of adjoining demesnes. And have they not exploded the puerile and petulant notion that we are isolated in an obscure corner of creation; pushed aside, as it were, like rough children out of good company. Instead of that we perceive our orb moving in the galaxy on a par with others, for of the all-pervading and sustaining influence of gravitation she gives as well as receives, and in proportion equal to any. Thus expanding the scripture doctrine into the heavens, that God is no respecter of *persons*, and that his tender mercies are over all his *works*.

Another common impression is, that human life runs from age to age in one unvaried round. It only seems to do so to unobservant minds. Life in the abstract is motion, but actual life is motion in fresh channels. There is no provision for either still life or renewing old routines of life. From some cause or other the scene is always shifting and its repetition

avoided. The rate at which it shifts, we may be sure, is adapted to our natures and our position in creation; too slow to be obvious to current observation, because intended to impart, with the sense of permanence, the advantages of permanence. Thus society to the living may seem stationary, but is not. We know it is not now with us what it was fifty or twenty years ago, and we have no reason to infer that it will be in the next century what it has been in this one, or in any one before this.

If we view life in a series of circles, expanding from those of individual existences, through tribes nations and races, to the orbit of the species, we cannot find two precisely alike. It is the same with the occupations of life. Each has a circuit of its own, made up of and merging into others of ever varying sweeps, for no art or profession could have any value or even subsist, if it were not linked to and interlinked with others. Then professions are changing, and science and art keep adding to their numbers. No phase of human life is therefore enduring, because its elements cannot be fixed. Not the circlet of a day in the experience of man, woman, or child is repeated without change. It is the same with all creatures, from the shortest to the longest of livers. There is doubtless variety in the scenes of existence of those that are born, grow old and die in a day.

Every natural fact arises from an antecedent fact, and this mutation in mundane affairs is a sequence of the changing condition of the earth herself. From center to surface she is, and always has been in process of change, as her recording tablets, her rocks and strata proclaim. There must be something great intended in this, and something not local here, but common to every sphere; at least it appears of too radical a character to be peculiar to one orb. To what does it point? To a feature in creation, than which nothing makes Infinite Wisdom more manifest, or more attractive—to the universal law of variety—the illimitable evolution of new forms and conditions from limited materials. By it, sources of variety are as exhaustless on the smaller as on the largest worlds—another striking proof of equality in the spheres however greatly they may differ in their external relations.

Had worlds and their products been made incapable of

change, life would (judging from our feelings) have been dull and monotonous in the largest, and unendurable in the least. Here, a perpetual recurrence of the same scenes and events would eventually cause all generations to think the same thoughts and act over the same acts. One common exercise of body and soul without a new result or the idea of one—not a single hope in the future, and progress impossible.

How beautifully the law of variety reverses all this; and while it provides for indefinite changes by giving permanency to none, as respects individual existence it gives the effect of permanency to all. To what antecedent cause is this great result the sequent? To one which has been recognised and named, but the nature of which science has not reached and perhaps never may reach. If it be an ultimate attribute of matter there is, of course, no getting behind it.

The range of physical causation terminates in the elements of matter—in atoms. In them are the germs of all material developments, as the rudiments of the tree are in its seed, or those of the bird in the egg. From them creation has *grown* and continues to grow, for their reproductive power can neither be exhausted nor impaired. They are not only the seeds but the materials of which all bodies are built, and carry with them *that* which gives variety and vitality to the universe—whatever it may be.

But the difficulty of conceiving how opposite or contrary results can flow from one and the same source has led to the doctrine of variety in atoms. To meet two great classes of phenomena two kinds have been held necessary—*Chemical* atoms, and *Physical* ones whose functions are thought to be only mechanical. In addition to these, to meet another exigence, *heat-making* atoms also have been suggested.

Now poverty in the virtue of ONE primordial element, is, we think, wholly inadmissible. If, on that account, two be deemed necessary, so may ten or twenty. If one be so poor in resource as to need the aid of another, with equal reason it may be held that the efficiency of two would be increased by an additional number. Then do not two kinds of atoms imply two kinds of *matter?* The fact is, if unity on this point be once invaded there is no security against further invasions.

The theory of Dualism, we believe, will be banished from

physics, however long it may be retained in ethics. From the limited progress yet made in the knowledge of nature's laws we are apt to multiply them for the solution of difficult points. This is not surprising, nor is it to be regretted. It is a natural if not a necessary step toward the discovery that in them, as in their effects, variety is the offspring of unity—that one cause springs from another, and gives birth to a fresh one, like the limbs, branches, twigs, leaves and leaflets, etc., of a tree shooting from one bole. Such, we imagine, is the case with the properties of matter, and that ATTRACTION is the bole, or the root of the bole, whence they proceed. At all events, if they do not spring from it, they center in it, and assuredly cannot subsist without it.

From it the law, or principle, of endless variety will be found to spring.

The bond of the universe, attraction holds the spheres in their orbits as it holds atoms in theirs; for it connects them, separately and collectively, as by elastic filaments, which, though stretched through infinity, cannot be broken, or lose their contractile power. Its influence in *drawing*, and ever tending to draw bodies together, and resisting their separation, has been a source of perplexity, from its implying an affection, and a yearning in atoms to join one another—characteristics of sentient bodies, and with a power to act on one another when apart which sentient bodies do not possess.

There is certainly nothing metaphorical in this, but, as an ultimate phenomenon it is irrational in the extreme to make our conceptions the standard of what is inconceivable, for how *any* property resides in matter is utterly incomprehensible.

Let it not then be imagined that there is no connecting agent between bodies because we perceive none. There are many things quite as mysterious, which being familiar to us excite neither surprise nor doubt. Had the elements of matter instead of clinging to one another, been made uncongenial, opposed, or indifferent to union, there had been, (we may infer,) either no distinct forms and masses, or forms and masses of dust. It is conceded that in no substance are they in actual contact, and that there may be as many degrees of insensible as of sensible distances, so that the phenomenon is quite as inexplicable in flying a kite and drawing it in with a

string whose constituent particles do not touch each other, as the earth drawing the moon after her.

If an ultimate cause, it matters little whether this ineffable influence be the immediate or intermediate work of the Creator. It is enough that it is from Him.

If attraction be considered as only drawing matter together, it would not account for diversity of forms and qualities, but viewed as carrying with it all the attributes of atoms, it will go far toward resolving all phenomena, if not all into one. We certainly do not know that any property of matter subsists, or that any action of matter takes place or can take place without it. All that is known points more directly to it, than to anything else, as the principle of action that comprises all other principles, or one whose touch it is that awakens them.

That mutation and variety come from it there is sufficient evidence, and such as seems to exclude the possibility of their ascription to aught else. As the influence of attraction, here and everywhere, is admitted to be ceaseless, it is only necessary to show that it is ceaselessly (though imperceptibly) *varying*. To do this we need but appeal to the fact that its grand sources, the spheres, are every moment varying their relative positions—that neither they nor the earth, sun, planets or moon ever pass over a foot of the same track in space—and consequently their reciprocal action upon one another is every instant varying, and every fraction of every instant.

Does not this show that the universe is conducted on the principle of ceaseless and endless change—that a rigid duplication of individual organisms cannot occur—that the law of transfiguration has neither cessation nor limits. Had it been otherwise, exhaustion of the Creator's resources might have been inferred.

As the interlaced fibres of the human brain are seen to establish a communication throughout the cerebral mass, so the proposed chart would give us a glimpse of the lines through which the nerves of the universe run from sphere to sphere, and how they inclose the whole in a network of attraction whose threads no forces can rupture, and through whose meshes not an atom can pass.

If our system were cut off from the influence of others we should have many changes in ~~the decomposition of~~ bodies, organised

but they would be limited to those of the earth's positions with respect to the other planets. If the number of these were less we should have less, and if our globe were the only one, life here would in time become a perfectly monotonous round. There could arise no new varieties of plants or animals, and, ultimately, there would be no difference between individuals, not even in ourselves. We should become fac-similes of one another. But as long as the earth revolves round the sun and is carried by him toward other systems, changes in her products must inevitably continue. This is the true influence of the stars—one of the causes of which few of us think, and still fewer dream that they are not on the earth but in the heavens, and yet are as surely there as that we experience their effects here.

As everything on the spheres contributes to and is affected by their reciprocal influence, there exists as direct a relationship between their products as between themselves—between their *occupants* also. However modified, their bodies are formed of identically the same material as ours, and are governed by the same principles; for matter is everywhere essentially the same, and the laws to which it is subject here everywhere prevail. This is no more than what might have been anticipated, for what would an external union amount to without an internal one. That would surely be an imperfect bond of the universe which embraced the lower forms and conditions of matter, and left out its highest developments. In attraction there is, so to speak, a blood relationship between the denizens of the spheres. It runs through the veins of them all.

Naturalists, in attempting to account for successive genera and species, have not appealed to cosmical influence, but they will, if we are right in supposing the problem cannot be solved without recognising its omnipresence and power. The philosophy of a watch could never be understood by the closest scrutiny of its wheels, separately or combined, as long as the spring is ignored. Investigation could result only in fruitless conjectures, nor can living mechanisms and changes in them be explained if this the mainspring be left out. Every assigned cause less than this, has itself to be explained, and that cannot be done without referring to another, and not

even then, for it would be but chasing the secret from wheel to wheel.

We rarely look beyond the visible and palpable. That which suffices for the business in hand is employed without considering what relations it may have to other matters. A separate cause is sought out for a separate effect. But in nature there are no detached causes or effects, while the nearer one approaches the ultimate, the more comprehensive it is in itself and fruitful of others. Thus wind, or steam, propels our ships over the ocean without having anything to do with the freight, while that which moves the spheres—the fleets on which all Creation's treasures are embarked—is the forming and conserving principle of both passengers and goods.

There is no force in the objection drawn from great intervals of time between the appearance of new and disappearance of old species. Nature's developments require for their maturity, definite but different degrees of duration. Of these we know little, except that they constitute an expanding series from hours, perhaps moments, to such as may require for units of measure, centuries if not decades of centuries. Natural causes are from the beginning. There can be no changes in, no interferences with, and no additions to them; hence whatever is mysterious is so simply because knowledge is not sufficiently advanced to explain it. It certainly is not for us, in the very infancy of our schooling, if not of our species, to limit periods or processes of nature's developments, and when they differ from our juvenile imaginings, rather than expand our views, call in special interposition of the Creator to sanction them.

To the slow but ceaseless mutations of the earth's strata her products must for ever conform in order to exist. One law of growth governs all, and, according to that law, species of animals, as well as of plants, come in their seasons. As well look for matured frogs from tadpoles within the period assigned for their ripening, as for new species within *their* ordained periods. But come as they may, they come through second causes, and the cause suggested meets every condition whether they are evolved out of old species or not.

Attraction being the all comprehending principle in nature, necessarily holds the same relation to science—is its exterior circle within which all others revolve. Successfully to penetrate them we must know something of it; and so it is that only since it has begun to be studied has Physics made any real or substantial progress. But how much has yet to be learned! Its workings in what is called instinct in animals have to be detected, and its operations on MIND explained—how it is that mental organizations are varied by or with the material.

Matter without motion is dead, and mind also. Besides the influence of its mutations and movements around us, its restlessness within us keeps the imagination from rest, both while we sleep and when awake. The slightest movement of the head deranges our dreams, and changing the position of the body disperses them; nor can they be repeated, because the condition of matter within and without has in the the meantime changed. Moreover their character is affected, by the nature, quantity and digestion of our food, while opium and kindred drugs evolve preternatural visions. Thus the restlessness of mind is explained by the restlessness of that which excites it. These, of course, are natural results of a natural law, and science has to find out what attraction has to do with them—and perhaps with mental and moral affinities also.

The idea that the capricious thoughts of men are subject to law, or belong to any system of order, may appear a wild one, and still be a true one. As in other things, discord in this may be harmony not understood. To superficial observation, our globe consists of miscellaneous substances in utter confusion, and not a few altogether worthless, yet the closer they are examined the more clearly is design in their disposition and essential value in them all, made manifest. This theatre of mental activity, we may be assured, is as strictly under law as its metals and minerals, its coals, limestones and granite, though we are not yet able to observe the workings of the law.

Intellectual progress, like everything else, must have a cause—an exterior and enduring stimulant—and what can it be, if not the one indicated? This is not making mind an emanation of matter, but matter the instrument for exercising mind. Extend the principle to all worlds, for if the true one it must be applicable to all, and have we not in attraction a simple, natural and sufficient cause for mental excitation and

progress on them all—however varied in their masses and volumes, their movements and products, their occupants and conditions—one accordant with the perfect sympathy which subsists between the material and immaterial, and which must subsist so long as the invisible is made discernible in the visible.

Material forms and motions are embodiments of Divine thoughts, varying infinitely with the thoughts. They are the lessons given us to study. We are to translate things into thoughts, for which purpose they have to be followed through all the multiplicities of their external and internal turnings. It is pleasing to contemplate the universe, as, what we believe it literally is, a SCHOOL—the spheres its class-rooms and to every class a room. In this school students can never be waiting for fresh tasks since an endless succession of them is established. Material are, and always will be, vastly in advance of intellectual developments everywhere. There is nothing questionable in this. It is but saying the Teacher is in advance of his pupils.

A proposition that resolves mental evolution on the spheres into that which governs their material forms and movements, may be unacceptable to some minds, but while creation is a panorama ever moving before an universal audience, and without intermission eliciting and expanding thought throughout that audience, we think there is no impropriety in supposing that which moves the spheres and diversifies their scenery, the instrument ordained for exciting intellectual activity upon them. In our theatres the scenery is changed, sometimes directly by men, and sometimes indirectly by weights, but the scenic machinery of the universe is invariably moved by gravitation under the direction of its Great Manager.

III.

SECTION I.—The ascription of so large a share of Creation's wonders to attraction may be objected to, and perhaps will be till ALL FORCES are found resolvable into ONE. A numerous progeny, they appear so dissimilar in their features and habits, that, to common observation, any relationship between them could not be suspected, much less that they could have a common origin. The prevailing opinion is that the phenomena of nature require, at least, a duality of antagonist forces, one to draw matter together and another to separate it. It is, indeed, obvious that if it be swelled or pushed out, it must be got back some way or other, since no force can be indefinitely extended in one direction without exhausting itself, or ceasing to produce motion or results; hence, it is said, if two great forces did not subsist to limit the effects of each other, the universe had been an impenetrable solid or an infinitely dilated fluid.

Still, unity of force seems as natural and philosophical an inference as unity of light, heat, or of matter itself. It is difficult to imagine the motive power of Creation a compound; to think the perfect harmony of its endlessly diversified actions and reactions is not due to something essentially single and simple of itself.

'But there are facts connected with chemical, electric, and magnetic movements which cannot be explained by the theory of *one* parent force.' Perhaps *not yet*. It is not to be expected that the deepest truths are to be sounded by infancy's plummets, and no one imagines science is matured or approaching maturity. There are certainly forces in operation which have not yet been discovered, as well as others not yet understood. But, passing them it is to physical or common force we refer.

Force is manifested by matter in motion. A cannon ball, a fly wheel, or the sails of a wind-mill have no force when quiescent. Bodies at rest are moved by bodies *in force*, that is, in motion. But how does a body at rest become itself a first mover? Invariably, we believe, by *expansion* or *contraction*,

and consequently the direction of the force is outwards or inwards. That is to say, all forces arise directly or indirectly, from the simple swelling and shrinking of motive masses, and can therefore only be resolvable into one which has the means within itself of producing these opposite effects. It must both contract and expand matter. Is there such a force.

To accord with universal analogy, if not with an universal law of development, we suppose the eldest or first-born of the forces was the progenitor of the rest. If we knew what the first condition of matter was we could tell what the first force was —supposing matter was æriform or concrete, and it may be assumed to have been one or the other. If the former, the force was a contracting one, there being nothing to expand; if the latter, an expanding one, there being nothing to contract. Now, the idea is generally accepted by the learned that the universe was originally a subtile fluid; and with this, ATTRACTION, the universal and omnipresent condenser, agrees more perfectly as the FIRST MOVER than any hypothesis based on repulsion acting within a solid nucleus; for that would imply either that attraction had been previously at work or that the constitution of matter is in mass, not in atoms. In a fluid universe then, repulsion could not have preceded attraction. The latter was the primogenial force, and if the primogenial the ~~everlasting~~ parent one.

(As we here understand by repulsion not a passive resistance, which it is sometimes understood to be, but an active energy, that sends forth matter and consequently force with it, we use the terms 'condensation' and 'expansion' with their equivalents, as convenient synonyms for attraction and repulsion.)

It will, we suppose, be conceded that repulsion has not the power to draw back what it displaces, besides growing weaker with the displacements. Driving matter outwards, it would continue to do so, if not checked, till the whole was accumulated, so to speak, on the outermost verge of space. Attraction is the converging power that prevents this, and hence, it is inconceivable that physical power could have been developed by repulsion alone.

But if the forces cannot be deduced from repulsion, because of its inability to recover matter it throws out, can attraction

push out that which it draws in? If it can—that is, if it can be shown that repulsion is the *offspring* of attraction—doubts respecting the unity of force would be lessened if not removed. That there are facts which go to prove this, we are constrained to believe until better informed. Before referring to them, let us observe that the necessity of repulsion as a primordial principle of action is not apparent, if force in an opposite direction to that of attraction be the purpose of its introduction. With us there is no force but what is sent in any and every direction, and made to react on itself; why then should nature require that which we do not. Are not our working mechanisms, in every case, based on the making one force perform the functions of two, a pushing and a pulling one, and do they not produce almost endless varieties of results? What more does attraction with repulsion accomplish? By depressing a piston or the end of a lever, or pulling down a rope, we cause water or solid bodies to rise, and is it thought that nature cannot make the descending force of gravitation produce an ascending one, and *vice versa*?

In some minds the idea would arise, that if two equal and opposite forces proceeding from separate sources were employed, one might sometimes have to wait for the other—the fulcrum for the lever, or the lever for the fulcrum. But if repulsion emanates from attraction, it cannot be absent when wanted, nor called out till wanted, nor appear except in just measure to the call; that is, if the same relations exist between them as between action and reaction in our ordinary machines. And such we think is the fact—that one is primary and positive, the other secondary and negative.

But admitting that attraction which never sleeps awakens repulsion, and that reaction is torpid till quickened by action, what are nature's fulcra? In the sense we have of such things, she uses none.* While we are obliged to employ intervening media for the transmission of force, she transmits it without them; but, if an agent is to be recognised between her forces and the resistances they overcome, we should say, on concrete spheres it is HEAT. It would, however, be more correct to say that heat, instead of being something interposed between attraction and repulsion, is repulsion itself.

The ordinary processes by which attraction elicits repul-

* Living mechanisms excepted

sion are *chemical* and *mechanical decompositions.* Of the first it is unnecessary to speak, as examples are ever before us. It is the second, the least obvious, to which we appeal.

Let it be premised that heat—all heat as we suppose—is, like sound or any other property of matter, an effect, not a substance; and that it is evolved, and was originally evolved, by *friction*, or molecules rubbing over molecules; and that friction *attends every kind and degree of pressure*, and consequently every movement of bodies and within bodies. Heat given out by mixing sulphuric acid and water, or water with quicklime, are chemical examples. If the question were asked, When was heat first evolved? we should say, when matter was first compressed.

It is assumed that at the beginning matter was an æriform fluid or a solid, and occupied the whole of space or a part of it. If solid, it was a mere center of a boundless area, and we should have to admit that heat was required to dilate and diffuse it, and therefore preceded friction. But if, on the other hand, it was a universal fluid, prelusive to being gathered into concrete spheres, the presence of heat would have been directly antagonistic to its condensation; and they who maintain the fiery hypothesis should account for its appearance as well as for its dispersion.

Although the idea has been derided, we think the fluid universe was essentially cold—cold as the attenuated ether in space is now, and that heat commenced with its condensation—that sensible heat is pre-eminently a product of concrete spheres; that is, of attraction which made them concrete. But if heat is confined to the spheres repulsion is also. Indeed, the inference is hardly to be avoided, that if repulsion be inseparable from expansion, it can only be in force where there is matter to expand.

As we have supposed, contrary to authorities, that the universal nebula was destitute of heat, it may be asked, How did attraction elicit repulsion in it? As in its separated portions, and as in their subdivisions—in that one, for example, of which our solar system is made up, gravitation urging the fluid to a common center, rotation, by a well known law followed; and the centripetal force thus generated gave birth to a centrifugal one that successively threw off the matter of the planets

and broke up the whole. That is, we suppose the parent nebula, under the influence of gravitation, began and went through the same process as its offshoots—that from its rotation all other movements have proceeded. It seems hardly philosophical to require a law for the whole different from that which governs the parts; nor do we see how that which is recognised in the one *can* be ignored in the other. From what movement but that of the whole could those of the parts proceed. They must have been in unison with it and analogous to it. If the theory of Laplace be true, it can no more be limited to separate systems than gravitation itself.

A centripetal and a centrifugal movement may be considered the original forms of attractive and repulsive forces, and consequently of condensation and expansion. Nor does this conflict with the position assumed respecting heat, as it was necessarily evolved by condensation.

We everywhere perceive properties of matter merging into their opposites, as light and dark, heat and cold, hard and soft, etc. Perhaps it will be said, these are, in each case, mere degrees of one and the same thing. We admit they are, and we are not sure that repulsion will not finally be resolved into diminished attraction. But let us look for an illustration of a force generating an antagonist one:—Metals are condensed to a limited extent by the hammer, or when pressed between rollers. During the process they become heated, in consequence of the violent displacement or friction of their molecules. Most persons have seen the cold end of a nail rod made red hot by the hammer. Oriental smiths of old occasionally worked iron without fire. In the present times we are told that, 'in some parts of Hindostan, and on the coast of Malabar, they communicate to it by beating the degree of heat requisite for rendering it malleable.'

Suppose we take a mass of iron and hammer it till it becomes of a red or white heat, we find it swells and keeps swelling with the heat. *Condensation is followed by and actually produces expansion; an internal force is excited which* OVERCOMES *the external one which excites it*—the very thing required in a parent force. Could a globular mass be thus treated and kept in a globular form, the effect would be more obvious. At first it would be reduced in volume, but as the heat rose it would expand with it into a hundred or a thou-

sand times its original bulk—into gas if the compressing power were continued. This is an experiment which we cannot carry out, but Nature is continually performing it in the center of the earth, and with more refractory materials than the metals.

As with every other principle of action, means are provided for us to diversify its application, to hasten the process and diminish the pressure—friction matches and detonating compounds are examples. We have the principle at our finger ends. Rubbing the hands together rapidly evolves heat, and our bodies, like the friction of two pieces of wood, might thus be made to consume themselves.

Now if, in the iron, condensation, the legitimate representative of attraction, *directly* evolved repulsion, the latter was not an original but a derivative force. It as certainly could not have appeared without the former, as that it ceased to appear when that ceased to act. And it did precisely what it does in nature—it *changed the direction of the force.* Can repulsion thus produce attraction? If co-eval and co-equal ought it not to produce it? We are very sure that expansion however extended, can never directly excite condensation. A watch is moved by the expansion of the spring, but further expansion will never wind it up.

Perhaps it may be said, attraction is excited when steam from heated water returns to the liquid condition. True, in that case it is *indirectly* excited, but from first to last repulsion depended on it and only existed by it, for attraction formed the liquid and the fuel to dilate it. Rain is a parallel case. Other illustrations might be cited, but we know of none in which attraction does not *precede* repulsion and give rise to it —directly in the constitution of bodies, indirectly in the movement of bodies. Masses cannot be swelled without heat, and as heat is, so is repulsion, the product of attraction.

In brief: attraction compresses matter, compressure evolves heat, heat expands the matter compressed and fits it again for attraction to act on it. Such appears to be the process of the composition and recomposition of all bodies, and of all forces within them and without.

In the constitution of the earth, the evolution of heat by compressure differs in different substances: an amount of friction that kindles some into flame is scarcely to be felt in

others. The highest natural temperatures are those of living bodies, and for the obvious reason that their consumption of heat is the greatest. It is that which prevents us from being collapsed into statuettes; and if there were not more than just sufficient to prevent that, we should be as incapable of moving from one place to another as stones or trees. We are constantly expending heat in exterior force and consequently crave at short intervals fresh supplies of materials from which to obtain it.

Though the proposition that both forces are manifestations of one principle may be rejected, it must be conceded that their *effects* are degrees of one and the same thing; expansion being diminished density, as cold is diminished heat and darkness diminished light. Then how will objectors dispose of the fact of expansion being evolved by an accumulation, instead of a diminution of condensing power? We submit that it points to the law of the succession and reproduction of bodies, and shows how it is carried out by a force that comprises all conditions within itself—a law which enacts that attraction (condensation) when carried to certain extents, shall break down bodies it builds up and thereby provide for recomposition of their elements—a law by which it repels as well as attracts, bursts asunder what it binds together, and renews what it destroys—a law by which

'Extremes in nature equal ends produce.'

Whether repulsion be considered or not, the offspring of attraction, it is of no secondary importance in the economy of creation. It is the chief *acting* principle in the concrete as attraction was in the fluid universe. Based on her condensed materials and their capacity for expansion, the earth's forces, except what we get from tides and falling water, are all,—organic and inorganic—expansive. We can have no force, or next to none, from and during the condensation of substances, because they are already condensed, while in their expansion there are no limits to it. In one case motion can be had only through minute distances, in the other through the greatest practical distances. With one we should be all but helpless, with the other our power is nearly omnipotent.

In the arts we are incessantly applying heat to loosen the bonds of attraction; in slightly or temporarily changing the condition of bodies, as in drying, softening and fusing them, or in their decomposition for mechanical forces, as when we convert water into vapor and other substances into gas. The key to unlock them all is heat, and in applying the key we, like nature, apply that which attraction provides, to open stores which attraction has laid up.

On concrete worlds forces must depend upon heat, and from their constitution they, and they only, are heat producers. it may perhaps be imagined that force might be obtained on gaseous or nebulous orbs from the continuous compressing power of gravitation, but motion, from the shrinkage, would be too slow to be of use and always growing slower. We can hardly conceive a mill-wheel could be turned once round in a twelve month.

However it may be elsewhere, here the general diffusion of a *common agent* of expansion was required, and we have it in one to which we owe more than has yet been explained, viz: *water*. It appears to enter into the composition of all bodies. Plants and animals are chiefly made up of it. A living being of a perfectly arid substance is an impossible conception: All are moist and all food is wet. With respect to force, the earth consists of three great departments—water, the expansile agent—fuel to expand it—and bodies, organic and inorganic, to be acted on.

There is then, we apprehend, this difference between attraction and repulsion: the former *produces*, the latter *expends* —giving out quickly what the other slowly stores up. It constitutes the running conduits through which forces are drawn from a placid reservoir. There are other points of marked significance: attraction is constant and uniform, repulsion is neither. It is moreover limited to the spheres, and consequently does not send like attraction its influence through the intervening ether. In natural bodies attraction and repulsion are delicately balanced; to cohesion we can add nothing or next to nothing in any, but for repulsion we can increase and diminish it in all. Again:—in all forces from men, animals, wind, steam, electricity, etc., there is a consumption or waste of motive material, which has to be replaced or motion stops. Whence comes the replenishment? Solely from attraction, which *expending no material* requires itself no recuperation.

Another point may be recalled:—The mass of iron was supposed to be resolved into its elements by compressure, but it might also be volatilized without pressure, i.e., in a furnace sufficiently heated: in which case the same result is brought out by diminishing pressure as by increasing it. The application of this fact to sustain the parentage of attraction is this: In both cases heat was the dissolving agent. Repulsion (expansion) called in fuel from without, but attraction (compressure) made the mass serve as its own fuel. Had it required aught extraneous, like repulsion, it could not be the all generating Force—THE GREAT HEAT-PRODUCER.

Heat has been appropriately named 'a radiating force;' and when it is said expansion abstracts heat, it is saying, what we affirm, that expansion expends force. Then, as condensation produces heat (and there is no force without it) that which produces condensation is the fountain of the forces.

SECTION 2. Illustrations drawn from iron of repulsion being a product of attraction may serve as a type of those to be derived from the arts. Let us now take one from nature, on the largest scale, and see if both do not accord, and under circumstances and conditions as widely different as can well be imagined.

It is admitted that gravitation would squeeze our earth and her atmosphere into a small adamantine mass, if it were not checked in some way or other. Now as it has continued to act from the beginning with unabated power, why has condensation abruptly stopped and left her and her associate planets in different and very moderate densities? And how are those densities preserved? The answer to the first question will be found, we think, conclusive, that repulsion is generated by attraction, and the reply to the second will confirm this by showing how an alternate preponderance is maintained of one force over the other.

The closer the constitution of concrete spheres is examined the more evident, we think, it will appear that every one is

a friction *Fire-mill*—that it generates in heat a central repulsive force in proportion to its mass, and consequently one that at length balances the compressive force without. The very existence of a planet is a proof of the presence of this force, and it fully accounts for diversities of densities, and for diversities of materials not combining in one compact body.

The temperature of the earth is known to increase with the distance from the surface, being as we assume, the effect of gravity crowding her materials into smaller and smaller areas and consequently heating them more and more as they approach the center, where the extremest of mundane heat is engendered (by friction) under the concurrent pressure of her entire mass. And there, as with the heated iron, it is expansion against condensation—repulsion *versus* gravity. When repulsion preponderates it displaces matter and, as it subsides, the other pushes down fresh matter.

Of those who believe this central heat part of a primordial fiery nebula, some doubt its permanence. The matter rendered by it incandescent, liquid and gaseous, must, they think, grow colder by radiation, and hence they infer that the mean temperature of the earth is decreasing. Others suppose it retains its original intensity, and will retain it to the end of time.

The error of both parties, as we take it, arises from contemplating the material of the earth as at rest, forgetting that a central expanding force is constantly disturbing it, that a ceaseless exchange of heated matter for cold is going on, and that from this cause, if from no other, *the whole is*, though imperceptible to us, *always in motion*, some portions *towards* and some *from* the center, and consequently that fresh heat is as copiously generated now as it ever was, or perhaps ever can be.

There is no room to question the reality of this circulation. Of the ascending movement every part of the earth's surface furnishes evidence, in marine formations in the midst of continents and on the summits of mountains. Where is there not sand and gravel, and limestone composed of shells and corals? To say nothing of visible discharges of internal matter by volcanoes, we have metals, granite, and other substances, raised within our reach. Wide districts of land are known to be now rising.

Nor is the descending movement less apparent, either upon or beneath the surface, as the abrasion of mountains by rain and the transference of detritus to lower levels, and through rivers to the oceans. Ancient cities are more or less deeply buried, and some have wholly disappeared. Large areas of lands are settling. But what is more to the point, geological strata have gone down with their fossil treasures in the order of their appearance on the surface, the oldest the lowest, and the latest immediately beneath us. In all times and countries they have thus followed each other, and at this day, as in preceding times, internal matter is coming up, and external matter going down—perfectly analogous to action and reaction in organic structures—secretion of fresh motive material and discharge of the waste.

The dense forests of the carboniferous and succeeding periods, where are they? Did they wither and perish on the surface? Not one of them. They sunk beneath it in the order they appeared upon it, and from vegetable have become mineral fuel, a substance of vital importance to human progress for all time. That the rate of subsidence of surface strata is subject to some law and one that checks the descent of divers matters at divers depths there need be no question. Coal probably settles no lower than suffices to receive the heat and pressure requisite to its perfect conversion, when it commences its slow ascent. It is not wanted to support the central fire, since the pressure there fuses materials more enduring. There can be no such lack of system as to permit it to go where it could furnish but a few partial and momentary flashes.

Incoherence or looseness of the materials is essential to these internal movements. It secures, what is also indispensable, *inequality of resistance* to the upheaving force, and keeps changing the location and direction of the weakest or yielding parts. Were the matter of the earth uniformly consolidated, instead of interchanges silent, slow, and continuous, there could be nothing but sudden explosions, with general displacements. But as things are arranged, the heterogeneous and detached character of the materials can only resist a comparatively moderate expanding force, while the part least able

at the moment to withstand it, gives way without disturbing the rest. It is only when these insensible movements are checked that sensible earthquakes occur; and that even *they* perform important functions, besides that of preventing consolidation, we may well believe.

Besides being indispensable for a continuous conversion of substances into other substances, it is this circulation of the materials of orbs that arrests condensation and secures permanency to planetary and solar volumes—a fundamental and universal principle we believe. But for it, half the matter of our earth would be comparatively of no use. The greater part would serve no other purpose than a foundation for a thin stratum on the surface; or it would be like surplus raw stock lying useless in a manufacturer's cellar; an idea repugnant to every principle of economy that characterises the Creator's designs.

The hypothesis of our planet being a shell, or crust, containing a sea of molten matter, is among the wildest of the wild. Its supporters seem to have no idea that law reigns within it as well as without, and with equally beneficent purposes and results; that every movement, the smallest as the greatest, is as necessary to accomplish them, as those within their own bodies are to keep them in health. Human progress, material and mental, is, we suppose, the chief purpose of the earth's creation and of our being put in possession of it. To this end, substances elaborated for the arts at vast depths are prepared and brought up by the system of circulation, and, when worn out or consumed are passed down to undergo fresh elaboration and be ready again when wanted—a system utterly incompatible with any shell theory, but in perfect harmony with the renewal of bodies on the surface, if not the foundation on which that renewal is based.

Were the theory of friction, as the primordial source of heat, considered in connection with this circulation of the earth's materials—much on the same principle as water circulates through a heated boiler, infinitely slower but not less certain—the origin and maintenance of heat in the spheres could hardly remain in doubt. A theory sufficient for the earth is sufficient for the universe—for solar as for planetary heat.

Though the specific gravities of the larger planets are less

than those of smaller, their masses are sufficient to generate the upheaving forces required, even were resistance to fusion greater than in our earth's alembic; but the probabilities are that it is less. Light and porous bodies are easier ignited by friction than heavy and solid ones. Fire is quickly kindled by rubbing wood on wood, but no one would attempt it with two pieces of metal. Internal heat may therefore be more readily generated in the elder planets than in the earth and her immediate neighbors; and from the same cause (their diminished densities) less amounts or intensities would be required—resistance to the upheaving force would be less. It may well be that densities varying with the masses of planets have reference to the generation of central forces—if these are so vitally important as we claim them to be.

If there are planets or satellites whose surfaces have never been broken by internal forces we should consider the fact as strong an indication of the absence of intelligent occupants as anything yet suggested; so essential to the inauguration and maintenance of vegetable and animal organisms does an interchange of internal and external matter appear. We believe an early and prolonged series of upheavals necessary to break up the originally homogeneous material and compact character of every planet, in order *to initiate variety of substances* and promote their development, by changing the positions, and consequently diversifying the conditions and reciprocal influences of the separated masses. And such movements we conceive were not less necessary to prepare a planet to become a theatre of life, than they are to keep it one. A first earthquake might be like an explosion of powder in the center of a solid rock, but subsequent tremors would diminish in violence with disintegration, till, as we suppose will be the case here, their pulsations with rare exceptions become unfelt.

The rugged and barren aspect of our moon would be accounted for, if the ante-vegetable period of eruption has not ended on her. She may, however, not have reached the point of compression which establishes a permanent and delicate balance between her interior dilating and exterior compressing force. Her density is little over six tenths that of the earth. She may still be contracting.

Those who teach that matter was intensely hot previous to the formation of the spheres—sensible that condensation

could not begin till the raging heat was got rid of—admit that "*some* great change must have taken place in it, since while it continued to act with its full repulsive energy the process of agglomeration by attraction could not have gone on." We hold it safer to infer that the principles evolved at the birth of creation were the same as are now in operation, that not one was evoked for a temporary or special purpose and dismissed when that was accomplished, and hence that the fluid universe could only have been heated as matter is now heated. Heat therefore could not have preceded condensation, unless it were in atoms, but as their attributes are as indestructible as themselves, had they been originally of a glowing heat they would be found so in every substance now.

One of the alleged functions of nebulous heat was to cause diversities of densities in stellar and planetary bodies. For example; when the matter of our system was at its highest temperature the outermost planet was thrown off, the next one when it was somewhat reduced, (though how we are not told) the next when it was further moderated, and so on to the earth whose matter was incandescent, then to Venus and Mercury. This, it is said, perfectly tallies with the exceeding diffuseness of the matter of the elder planets; Saturn not being denser than cork, etc. Now, all this, we think, may be accounted for on common grounds and acknowledged principles without calling for an universal fire attended with no small difficulties of disposing of it. That is, by making attraction, not repulsion the *first* acting principle. As a gaseous body, the density of the nebula of our system, if cold as the climate of Siberia, would, by gravitation, have varied from the center to the circumference, and there would have been the same differences between that of Saturn and the other planets as there are now. For such a purpose an intensely heated fluid was certainly not required. It might retard but could not vary the result.

Then, by what processes was one portion of the fiery mist got into and locked up in the deepest of planetary prisons, and another gathered round the sun as a luminous envelope? —as some teach. We believe no satisfactory solutions of these enigmas have been given, while fresh embarrassments arise at every step. In both cases the difficulty of accounting for the maintenance of the heat is felt. Some philosophers

think there is no diminution of it in either, others admit a slow but constant outlay in both. The sun, they say, is wasting away by the emission of light and heat. The hypothesis is laden with difficulties. We prefer the one proposed in this paper. By it a heat generating orb can no more waste away than a non-generating one. The heat given out is perpetually renewed, and with no more waste of matter than motion or sound wastes it.

"The existence of this central heat—a residuum of that which kept all matter in a vaporiform chaos at first—is among the most solid discoveries of modern science, and the support which it gives to Herschel's explanation of the formation of worlds is highly important. We shall hereafter see what appear to be traces of this heat upon the surface of the earth in very remote times; an effect however which has long passed entirely away. The central heat has, for ages, reached a fixed point, at which it will probably remain forever, as the non-conducting quality of the cool crust absolutely prevents it from suffering any diminution."

It is bordering on presumption to dissent from this—the orthodox doctrine on the subject—but it is better for independent thought to be rebuked than suppressed. Through what channels did the earth's central heat leak, and how have they become closed? Into what could it have been drained? Where was there cold matter to receive it? But supposing it went off somewhere by radiation, why should it not still escape in that way, and more copiously because of the vastly reduced temperature of the matter now enclosing it. If ancient earthquakes discharged much, modern ones are constantly occurring, besides one or two hundred volcanoes, to give it vent. Its present temperature is deemed so intense that no scales have been projected to measure it, and yet it is spoken of as *much less* than that of the nebulous earth when thrown off from the parent mass. Who, then, can conceive the alleged heat of the fluid universe, tell whence it came, or establish the necessity of it.

That a body of heat generated when all matter was fluid, *could* be kept alive by itself in the bowels of this, or any other globe, is, to say the least, exceedingly problematical. It is not represented as coming down through a past eternity in other matter, but in a portion of the primordial nebula it-

self—in a portion of the pure and homogeneous material of creation, ere variety of forms and substances had begun to be evolved out of it. Moreover it is represented under conditions that render it positively incapable of producing effects ascribed to it. Shut up within a non-conducting crust, something like high steam in a non-conducting and perfectly closed boiler, *exterior* movements are attributed to it, as if it, any more than the steam, could produce them without coming out of the envelope. If it impart heat to matter outside, it loses forever what it imparts; nor can it displace bodies outside without expanding itself to reach them; and if it expands it expends what it expands, for that which once passes out cannot be drawn back, whether issuing slowly by radiation or instantaneously by impulse.

Hence, if it were possible for such a body of heat to have been preserved as alleged, its preservation would be without a purpose, since it could accomplish nothing—no more than a buried steam boiler from which no steam could escape. We prefer to contemplate it in the light of experience, without the danger of offending known laws, or the invocation of unknown ones. That is, instead of being an everlasting fire of celestial origin, dating from the beginning of creation, it is a common product of the earth, constantly wearing out and being constantly renewed—that as a force, it differs in no respect from other expansive forces in its origin, action and means of support.

The nature and functions of central fires of planets and satellites have yet to be investigated. They are too commonly viewed as simply injurious, and as for our earth's glowing furnace, the sooner it is extinguished the better! That it was a necessary element in her constitution its existence is sufficient proof, and we venture the assertion that no reasons can be adduced for its introduction which do not sustain the necessity of its continuance. Without it her entire economy would become deranged. Her density and dimensions would vary; she would become a compact, impenetrable solid; the subsidence of worn out surface strata, their replacement by fresh strata, and the interminable variety of results would cease. If even the metamorphose of vegetables into minerals, transmutations of the latter, and their ripening at great depths were not arrested, they never could be raised within the grasp of

our miners. In a word, we suppose the successive appearance of mineral, vegetable, and animated bodies depends in no small degree on the earth's central furnace—a fixture in Nature's laboratory as indispensable as in the chemist's.

If it is dying out, the inference would be that it had fulfilled its mission, and that things here were about returning to chaos, though the earth as a theatre of life is obviously in comparative infancy, and our location upon it, as it were, but yesterday.

As the original homogeneity of matter has been alluded to, the query naturally arises, By what means were divers substances evolved from it? We should say by attraction, through diversities of conditions it introduced. When the nebulous earth turned on its axis it lost the uniform character of its material. Its density varied from surface to center, and kept increasingly varying as condensation progressed and solidification set in. The mass might then be considered as composed of innumerable concentric layers, each differing in *texture* and in *motion* from the rest. Two permanent elements of diversity were then initiated, and with them a third one, viz: *heat*, the effect of condensation. 'Admitting that, the material of individual layers would still be homogeneous.' Yes, but the next step was the evolution of a radiating force to break, and keep breaking through them. Attraction did this, also, by generating the central upheaving force; and by the continuation of that force, it multiplies changes of condition on the principle of permutation, and renders the recurrence of, or approach to uniformity impossible. Universal gravitation appears thus to have opened the way for cohesion, chemical, electrical, and every special variety of attraction, to enter on the work of converting an uniform mass into the variegated orb we inhabit—evolving crystalline forms, vegetable structures, animated bodies, and the circulation of living forces.

To close the suggestions of this paper, (they are nothing more) we submit that, that which excites repulsion in the earth as a whole, excites it in her parts—that the various densities of her materials are due to the same cause as is her aggregate density—that in them cohesion goes on, till molecular friction evolves repulsion in heat and thus establishes the series of natural temperatures, organic and inorganic.

(In living organisms, soon as the process ceases, the coldness of death supervenes. Of the constitutional heats of the lower forms of life, aquatic, terrestrial and ærial, little seems to have been determined. They are presumed to bear a direct, if not a constant relation to muscular power. Fishes in general are but slightly warmer than the waters they live in, but there *must* be a marked range of temperature between the inert and energetic—between the coral, the oyster, the sole, with other slow swimmers; and the dolphin and tunny, the shark and the swordfish, and still huger indwellers of the ocean whose expenditure of force is enormous.)

Without some hypothesis akin to the one proposed, we cannot account for condensation stopping at different stages in different bodies, nor for its stopping at all in any. There are, doubtless, details to be reconciled before it can be accepted; we can, however, think of none presenting greater difficulties than condensation producing expansion, and *that*, if admitted, will go far towards establishing the doctrine that ATTRACTION is the root from which all forces spring—the weight, as has elsewhere been stated, which moves all the clock-works of the universe, and by its offspring HEAT is ever winding them up.

NEW YORK, January, 1862.

THE END.

ADDENDA TO SECOND EDITION.

In what order did the physical forces appear? or is the dogma tenable that they arose simultaneously? Clearly not, unless the raw material of the universe was a heterogeneous mass in which every one found at once something to do; and from such a commotion what conceivable result could have followed but chaos made more chaotic? But neither turbulence nor confusion reigned over the first movements of matter. That is a supposition unworthy of the slightest credence. It receives no sanction from philosophy.—Creation is preëminently a work of law and order, and nothing is more certain than that these pervaded the fluid as thoroughly as they pervade the present universe. As no regular form or motion can be produced by the submission, if that were possible, of an amorphous mass to the conjoint action of a thousand different influences, the inference is irresistible, that the forces made their appearance in a regular sequence, i. e. as the progressive changes in matter called for them. How, indeed, could they appear till the conditions were evolved upon which their evolution depended?—Could there have been cohesion before gravitation, capillary action before liquids were formed, or vital energies ere living bodies appeared?

We are assured, then, that the action of a first force was necessary to prepare matter to receive the impress of a second, of it for a third, and so on. We have also assumed that the entire system

of creation—its order, harmony, its integrity and stability, arose out of and is sustained by the Leading Force; and that this force must be essentially different from all others in its origin and attributes; that it exists independently of them, and that they exist only in and through it; that no changes in the condition of matter can affect it; that it is continuous in its action and invariable in intensity, from everlasting to everlasting.

What is it? We have said Attraction. But Attraction has various phases which, developed under certain conditions, could not have preceded those conditions. There is but one answer to the question. As Attraction was the first force, GRAVITATION was the first form or phase of that force; and consequently the one which gave the first motion to matter, and opened the grand working scene of Creation. Derivable from no second cause, other forces proceed more or less directly from it. They are inconstant and variable, but with it there is not a shadow of turning. It acts ceaselessly on the whole material of the universe, they only on parts and interruptedly. We can elicit, modify, oppose and extinguish other forces, but we can neither touch nor tamper with Gravitation. No finite power can do that. We are at no loss to imagine how it started the dark, and cold, and dead universe into life, by gathering the material into constellations, systems, and individual spheres; evolving repulsion in heat by compressing them; and, by varying their densities and temperatures, giving birth to the minor forces; and we understand how it holds the materials of our orb (and those of all orbs) together without interfering with the action of minor forces on them—how, in short, it governs the whole while they bring out details.

What intervals occurred in the successive evolutions of inorganic, vegetable and living forces, we can never know, nor is it of importance that we should know. That they extended over periods that would stretch the imagination to comprehend may well be conceded, wonderfully bold and soaring as human speculations on the

cosmogony have been and are. It would, however, be a substantial gain to know, not only that every change wrought in matter by one force was taken hold of by another which the change was the means of awakening, but also the position of each in the series. If Gravitation was the first, what was the second, the third, and so on to the latest. It is certainly with the growth of worlds as with the smallest objects. The forces that develope and mature them follow in as regular an order as those which bring forth a tree laden with fruit, from a seed. And, as we cannot entertain the thought that the universe is ripe, or any fruit-bearing sphere in it, we think the probabilities are that new forces have yet to appear with changes of matter not yet reached.

The aggregate amount of Force in the Universe is a problem of the highest interest in the economy of worlds. Is it the same now as in the beginning? Some suppose it is, and will be under all conditions of things. How then is it distributed so as to be nowhere deficient or in excess, since without some laws on this point, creation would run into chaos. The answer is; the amount of force depends on that of matter—is invariable as that of matter. In other words, the motive power of the universe is derived from Gravitation, and can therefore neither be increased nor diminished an iota, here or anywhere else.

Such is one opinion, but one too hastily made up. That the amount of force is variable of which our planet is the depository is certain. That there are forces in play now which were not developed when the earth was a nebulous body, is unquestionable. And are not the vast and vastly increasing ones artificially excited in steam, gunpowder, and other agents in innumerable processes in the arts, to say nothing of her varying populations, proofs that there is no uniformity here in the consumption? It is true that man can no more create force than matter, but he can use or neg-

lect to use it; and herein lies the difference. The opinion quoted recognises no distinction between income and outlay. It seems to be based on the idea that the current supply is the current expenditure, without any capital laid up to fall back on; whereas such capital is the only source to draw on. We can obtain no force directly from gravitation. It is only through matter that has received its impress that it becomes available.

There could have been no difference whatever between the present universe and the fluid one, had there not been an accumulation and conservation of force in the materials condensed. It is by them it has grown to be what it is. It is the force laid up in them that has rendered it habitable to physical organisms. In the substances from which we obtain force, gravitation has been storing it up from the beginning, and keeps on storing it. The aggregate amount latent here has therefore never been stationary—perhaps always on the increase. In modern times, man has drawn more largely on the fund than heretofore, and the probability is, and the hope too, that he will continue to increase the number and amounts of his drafts, since there is no danger of his exhausting or even diminishing it. Force is here a perennial font that neither settles nor overflows. And as with our planet, doubtless with others, essential as it must be to physical intelligences everywhere. The foundation of all progress, mental power has a direct relation to the developments and applications of the physical.

The leading and all important product of the concrete universe, every sphere is made a storehouse of force and of materials to be elaborated by it. To what but Gravitation is it, or can it be ascribed? To gather matter into worlds and to regulate their movements would have amounted to little without this impress of itself within them. The power that did one could alone do the other. Great as Gravitation is, its grandest function is within the spheres, though commonly imagined without.

Original incandescence of matter: There appears something very forced, and conflicting with every analogy in nature, in making creation begin with all matter on fire. We know not how to accept an hypothesis that makes heat precede cold, and light darkness, and commences the process of development by extinguishing both light and heat; and that too, to bring them forth again. The oldest cosmoganists made Day the offspring of Night. So with the Mosaic account: "In the beginning God created the heaven and the earth—and darkness was upon the face of the deep. And God said, let there be lights in the firmament of heaven." This appears natural, and is philosophical. Utter darkness and consequently intense cold pervaded the fluid universe; and the movements began by breaking it up into spheres—by studding the firmament with greater and lesser lights—with solar lamps and planetary reflectors. Not that they burst into brilliancy at once, or simultaneously, but that each became gradually lit up as heat was evolved from its material by condensation, and this not as a distinct operation, but one progressing in common with other developments.

As the laws that govern matter never change, it is safe, in fact the only mode of acquiring positive knowledge, to compare its action in nature with its behavior in art. Now experimental philosophy teaches us that if the material of creation were originally fluid and incandescent, it would, if resolved into its original form, resume its original temperature. But if the teachings of Physical science can be relied on at all, expansion generates cold. Of this there can be no doubt, and hence the inference is that primordial matter, instead of being densely heated, was destitute of heat. Indeed, it would seem preposterous to suppose, in direct conflict with the fundamental law by which temperature diminishes with expansion, that the dilation of the spheres into a thin fluid could result in aught but a gelid one. If so, it was originally gelid. Consonant with this is the fact that in the existing universe heat most abounds where

matter is most crowded—most in the spheres, least in the ether. How this can be satisfactorily explained by the igneous theory we do not know. By the cold one it is a natural and philosophical result. That is, gravitation began the work of elaboration by compressing the cold primordial nebula into heat-generating orbs—converting an original frigid into a warm and genial universe—and while it was thus storing up in heat the element of expansion in condensed nebula, it was at the same time inducing expansion in the uncondensed—preparing an atmosphere for the orbs while they were being prepared for it.

It is worth remarking that this double effect of attraction is as common in the concrete as it was in the fluid universe. It never condenses one body here, large or small, without dilating another—commonly the atmosphere, and therefore not perceptible. That was a true saying of some old philosophers, "Nature abhors a vacuum." She has made no provision for one.

The Ether.—It may be thought that the cold theory is attended with as great difficulties as the igneous one. We may be asked to account for the separation from the parent mass of that portion of matter which constitutes the ether, and how it escaped being gathered up in the spheres. Is there not here as perplexing an enigma as any attending original incandescence, how the heat was produced, what purpose it accomplished, how the spheres became solidified in spite of it, and what became of it? No. It is not difficult to find a rational and philosophic solution, or, at all events, one that appears such. If we extract from a close receiver any part of the air with which it is charged, no space is for a moment left vacant because of the dilation of the remaining part. But suppose, instead of withdrawing any portion, we could, and were to compress one-half, two-thirds or nine-tenths of it into minute liquid or concrete globules, the remaining fluid would dilate *pari passu* with the condensation and occupy the whole interior. Now something like this we suppose was the process by which the greater part of the fluid that filled the universal receiver—boundless space—was gathered into the spheres, and the remainder dilated into the present ether.

The nebulous matter of a system or a solitary orb could not be drawn together and leave a vacuum outside. In one respect the nuclei might be likened to sponges: each drew upon the surrounding fluid till absorption ceased with saturation. The residue constitutes the atmosphere of the universe, and may be as vital to it as our atmosphere is to our earth. Whether the spheres could have been formed under the prevailing laws of matter without its agency we need not inquire. Its existence proves that it was indispensible to their formation and is so to their conservation. Possibly one of its functions might and may be allied to one that our atmosphere performs—that of a recipient and diluent of forces—a medium in which the most violent harmlessly expire.

We consider, then, the attenuated matter pervading space as not only a definite proportion of the mother fluid reserved as the medium for the spheres to move in, but, so far as relates to perceptions like ours, a fair representation of what the fluid universe originally was. Its density is of course less than when the substance of the spheres was diffused through it, but its character may have been no more affected by that than air rarefied differs from the same air unrarefied—than a less quantity differs from a greater. It was condensation that began the changes of condition in matter. If pure, primogenial matter anywhere abounds we know not where to look for it but in the ether: nowhere else is it, or has it been, less subject to change. It does not appear to coalesce with the alloyed masses, nebular and concrete, moving through it, so that whatever influence it exerts on them it would seem to preserve itself intact.

There is one point respecting the ether which may be thought to sustain the fiery hypothesis. Its *low temperature* may properly be ascribed to expansion in consequence of the absorption of so much of matter by the spheres; but then, by the same law, the incandes-

cent material of the latter should have been made still hotter by condensation; as red-hot bars of metal become of a brighter red by passing through rollers. And should not the high temperature have continued as well as the low one, since the condensing power has no more ceased to act than the expanding one. Accept the theory of a frigid fluid universe, and all seems clear.

Unity of Force.—We can have no idea of force unless associated with resistance, nor can we perceive how the action of a uniform force on a homogeneous mass can produce diversities of results; hence the theory of attraction and repulsion. But if these are what they have been represented, coeval and in every respect co-equal, so far from nature's varieties being deducible from them, there could have been no motion at all. Two opposing forces, equally powerful, invariable and independent, would neutralise each other—the form and condition of primordial matter could not have been changed by them. Under this and every other aspect of the doctrine of a plurality of original energies, we cannot resist the inference that there must be ONE controlling power from which others proceed and to whose impulses they respond. In short, that repulsion is the offspring of Gravitation.

Another consideration: All phenomena are confined within two conditions of matter—the aeriform and concrete. Intermediate conditions veer between these, and are, in fact, modifications of them. We do not know that any form or substance can pass outside of them, or that matter, under the present constitution of the universe, can have any other mode or state of being. But passing that, the fact that the sensible changes to which it is subject are confined within them is significant. While it proclaims the general movements of matter it makes known the general functions and directions of force—that it is expended on the evolution of the two simple but all-comprehensive conditions named. Now, we have shown, or, if it be thought we have not, we are sure it can be shown,

that the generic operations of gravitation are condensation and expansion—that it is expended in compressing gaseous into solid bodies and dissolving the solid into the gaseous, and that it thus covers all the motions and changes to which matter is subject.

Be it also remembered that the conditions aeriform and concrete are a unit, mere degrees of DENSITY; and further, that force itself is simply CHANGE OF DENSITY—arising from internal movements of bodies undergoing such change. Density may therefore be considered the basis of variety in the constitution of bodies and the universal measure of force. But does it not indicate something more? We think it sanctions the proposition that Unity of Creation implies Unity of Force.

The dual theory is strikingly akin to those conceptions of Nature's phenomena which mark the early history of most people. Almost everything had a double origin, as light and darkness, pain and pleasure, growth and decay, life and death, &c. There were moral attractions and repulsions; the evil principle warred within man against the good; and there were, of course, two supreme deities from which the opposing principles proceeded. In religion polytheism naturally precedes monotheism, and, as it would seem, dualism monism in philosophy. What is this but the growth of wisdom in both. To apply the dual origin of things to Force seems as repugnant to philosophy as its application to religion or to matter. If unity can be inferred in anything it surely must be in that which took hold of matter at the beginning, formed it into worlds and produces every form and motion within them and without; that invisible, intangible, illimitable energy which directly represents the Power of God, which in fact is that Power. Gravitation has no second cause, or if it has, it is reserved for a higher order of intellects than ours.

Dualism requires principles of *different natures, original and incapable of being derived one from the other.* By the theory sug-

gested in this paper, there is no property or condition of matter but merges, when carried to certain extents, into an opposite condition, as exemplified in condensation producing expansion. The continuation of motion in one direction is impossible: sooner or later it, like the track of the circumnavigator, returns upon itself, and the point of turning is antipodal to that of starting. Heat is a form of motion: communicate it to a mass of metal, it enters at the surface and returns from the centre. This is analogous to pushing and pulling in mechanical forces, to attraction and repulsion in chemical forces, to positive and negative electric forces. In fine, we deny, maugre appearances, that there is, or ever was, two conflicting elements in nature. She does not war against herself. We would as soon admit original repulsion in morals as in matter, for both are in the same category. That which is the life of creation, and more allied to the spiritual than anything else conceivable, we can never contemplate as a compound.

Time and Force: By a series of popular metaphors, poets and writers on morals have showered upon that which is absolutely innocuous and quiescent most unseemly designations. It is not Time that crumbles the pyramids and sweeps man and his works away; the Great Destroyer, what does it destroy; the Ravager, whom does it injure; a Thief, what does it steal; Swift Winged, it hurries no one. Time is a passive spectator of the doings of Force, and, instead of a scythe, should be represented with a mirror to reflect the changes which Force is ceaselessly working out in the vast fabric of Creation.

A word more on Friction as the source of heat.—So far as I can perceive there is not an operation in nature from the least to the greatest, that conflicts with it. According to it, heat increases with pressure, and therefore with mass; hence the luminous

sun and non-luminosity of the planets, the mass of the former exceeding that of all the latter combined; hence the coldness and darkness of space where the means of generating heat and light are not. Then the temperature of our earth increases with pressure, from her surface to her center as already remarked; but we ought not to have stopped there. Another test was at hand; the atmosphere diminishes in temperature and density upwards. The lowest stratum is the warmest, and every superincumbent one less warm because of diminished pressure. We may never know how high nature's scale of density rises, but what appears to be the lowest degree, the ether outside of our atmosphere, is almost within our reach. From its tenuity and the absence of pressure, its estimated temperature, 100° below zero, may approximate the truth.

We have said the earth is a friction fire-mill, and we might have added that if it were not incessantly grinding out heat nothing that has life could exist upon it. 'Although the sun is the most obvious and conspicuous source of heat for the earth, it is by no means the sole source of the enormous quantity that streams away in all directions from his surface, the earth receives but a small fraction. But it is neither lost nor wasted: he not only warms the earth, but assists to warm the universe. Our globe catches a trifling portion of his rays; but the rest fly onward to distant regions, where all are finally intercepted by the wandering hosts of orbs with which the heavens are filled. And what the sun does, all the other stars and planets are doing. A mighty system of exchange is established among the bodies in space, by which each radiates heat to all the rest, and receives it in turn from all the rest, according to the measure of its endowments. The whole stellar universe thus contributes to our warmth. It is a startling fact, that if the earth were dependent alone upon the sun for heat, it would not get enough to make the existence of animal and vegetable life possible upon its surface.' *Youmans.*

To say that heat is a common product of the earth would be say-

ing little, because it is the most common and most essential. It has, at least, three distinct sources from which it is ceaselessly streaming. 1. Gravitation, as already remarked, by compressing the whole of her materials into smaller and small spaces, kindled and keeps alive her central fire; a feature as essential as the heart is to a living body. 2. Every individual, form and substance is an independent heat producer. It generates by attraction of cohesion the temperature natural to it. The fact is obvious in living bodies, and would be equally so in vegetables and minerals had we organs or instruments fine enough to penetrate them. 3. Every body that moves, or stirs, in or through earth, air, or water, evolves heat. Not an eyelash is raised without adding to the stock. Every earthly atom is ceaselessly producing it. However various its other functions are, it never stops fulfilling this one. Why all this provision for the perpetual evolution of heat here? Because it is the most precious and prolific of mundane products. Without it, we could have no other.

There is not an earthly object, or substance, of any value or use of itself, that can accomplish anything of itself. So it is, we believe, with the spheres themselves. In the matter of heat how forcibly is this truth impressed upon us. While the quantity generated here greatly surpasses all external supplies, they are absolutely indispensible. Suppose our orb isolated from others; outcasts of creation, we should grovel in outer darkness, and benumbed with cold, perish with chattering if not with gnashing of teeth. It is our relation to other orbs that prevents this. Connected by the most precious of bonds, we receive from them, in solar and stellar heat and light, blessings that defy the imagination to conceive greater. However foreign to us some solar products may be, none could be sent us so precious as these.

We are not prepared to accept an old hypothesis, though revived and sanctioned by living authorities, that our great luminary is a mass of molten matter, its surface agitated by waves of flame and

it nucleus subjected to violent commotions. A mere flambeau, as it were, to warm and light up our planet and others. If we had to construct lamps a thousand times larger than our apartments there might be some grounds for belief, none otherwise, that we can think of, unless the glowing sphere really is, what a learned clergyman of the Church of England makes it, the central receptable for impenitent sinners of the system—an hypothesis not cumbered with the problem most perplexing to modern scientists—*whence* the material by which the combustion is kept up. (See Swinden's Enquiry into the Nature and Place of Hell. London, 1714.)

The chemical unity of the whole planetary system has long been surmised, and the recent analysis of the sun's atmosphere by MM. Kirchoff and Bunsen have, it is said, demonstrated the identity of solar and telluric substances. Iron, copper, nickel and zinc are common metals here. They appear to be quite as common, if not more so, in the sun. The discovery will lead to improved views respecting the constitution and temperature of the sun's interior. To say nothing of other materials, it is difficult to conceive how the metals just named can be generated in 'an incandescent liquid globe,' which M. Kirchoff thinks the Sun is. (See Smithsonian Report for 1861.)

Mental culture is the criterion of human progress. To what a limited extent it has yet been carried out is apparent in the fact that in every state of enlightened Europe the great body of the people is represented as the unthinking multitude. Then, how far below even them are the populations of savage and semi-civilized lands. Under the most favorable views the amount of THOUGHT in the world is startlingly small; and how much of it is, even among peoples the most advanced, inane, puerile, superficial, and mere repetition! Deduct what is not original—the only real additions to the stock—and how minute the balance. Is this indicative of degeneracy in the species, as some would infer? No. This balance is, we believe, larger and of a better quality than has characterised

the Past. The contributions of our age have certainly exceeded the nett products of any previous age. We believe so because we believe our species is in its infancy, and consequently that it is neither remaining stationary nor retrograding, but growing in intellectual power and activity. A child has no idea of what he will be in vigorous manhood; and our race seems equally unconscious of what it is to grow up to. The world has had, now and then, a few precocious students, but probably no better or closer thinkers than the average man of the race will one day be.

New York, May, 1863.