SOUTHERN PRESBYTERIAN REVIEW.

NUMBER I.

JULY, 1852.

ARTICLE I.

SPIRITUAL BENEFICENCE.

The Divine Law of Beneficence. By Rev. PARSONS COOKE, *Lynn, Mass.*

Zaccheus; or Scriptural Plan of Benevolence. By Rev. SAMUEL HARRIS, *Conway, Mass.*

The Mission of the Church; or Systematic Beneficence. By Rev. EDWARD A. LAWRENCE, *Marblehead, Mass.*

The Faithful Steward; or Systematic Beneficence an Essential of Christian Character. By Rev. S. D. CLARK, *Ashfield, Mass.*

Several years ago, a benevolent individual, unknown to us, offered a premium of two hundred and fifty dollars for "the best approved treatise on the importance of *Systematic Beneficence*, and of statedly appropriating certain

* The following article was written by a New England man, and its phraseology conforms, in some places, to the systems of charity in operation in that section of our country, viz. the *voluntary associations*. But its principles are equally applicable here as there. Perhaps they are more so, since no *general* system of beneficence can be more perfect than that of the Presbyterian Church. What we need is, not to perfect our system as a whole, but to carry it out more generally and perfectly in its bearing upon particular parts, and upon individuals. This result it is hoped the article before us will have a tendency to produce.—[*Eds. S. P. Rev.*

ARTICLE III.

THE CEASELESS ACTIVITY OF MATTER.

It is our purpose to show, in this article, that every particle of matter is ceaselessly in motion,—that not an atom is ever at rest.

To our senses the universe seems still; and close observation, during an appreciable interval, is necessary to discover motion in the heavenly bodies; yet Astronomy demonstrates that planets, suns, and systems, are performing various complicated revolutions with fearful velocity. The Earth, for example, moves in its orbit 68.000 miles per hour. Absolute stillness of matter is therefore impossible.

An uneducated man regards the earth as the emblem of stability; though the Bible tells us of its creation, its chaotic state, its re-adjustment with continents and oceans, its deluge, and its future destruction by fire, followed by new heavens and a new earth; and, in accordance with this character of mutation, geology demonstrates that the planet, during the countless ages of its progress to the recent period of man's creation, was the scene of inconceivably great, numerous and protracted changes, in continents, oceans, and organic beings. To the geologist, the earth is the emblem of change.

So, most persons habitually regard a rock or a grain of sand as an inactive, motionless thing. The chemist views either in a very different light. His mind's eye sees in it atoms as numerous as are the stars in the vault of heaven, and performing motions relatively as regular, ceaseless and great, as those of the planetary bodies. He knows the grain of sand to exceed in size 1,000,000,000 of animalcules, of which 500,000,000 swim freely in a drop of water, and each of which contains thousands of compound atoms; and he can, with a good microscope, *see* the visible motions of the animalcules; so, science teaches him, with equal certainty, that myriads of atoms move, incessantly, in a grain of sand or a particle of gold. "Accordingly," says the learned and pious Harris, "even the repose of nature is only apparent. Not an atom, not a world is at rest. The

simplest and minutest body is the subject of *internal* movement among the particles composing it."

Subjects closely allied to this were much discussed by the philosophers of antiquity and by the schoolmen; but ignorance of science caused these discussions to end in wild conjectures or false theories. And though incidental allusions are often made to the constant motion of all material atoms as probably true, we are not aware that any one has attempted a demonstration of its truth, since the atomic constitution of matter was rendered almost certain by chemical laws, and especially by the phenomena of isomorphism. The subject has often forced itself on our attention; but as the aspect in which we aim to present it is certainly new, we rigidly limit our arguments to admitted facts and established scientific principles, sternly rejecting, with a single exception, all assumptions, and excluding all theoretical considerations. And that single assumption is the material, atomic constitution of matter, on which chemistry and all the physical sciences rest. Hence, all philosophers now reject the metaphysical hypothesis, which resolves all matter into properties, and regards all things as ideas; because it saps the foundation of human belief, and leaves the mind in a hopeless state of bewilderment.

Assuming, then, the existence of matter, chemistry has proved that its particles are not, as Epicurus taught, uncreated and eternal, but that they are, as he believed, indivisible, inert atoms, inconceivably minute. By their union, not in consequence of inherent, self-originated motion, but in obedience to definite physical forces, impressed upon them by Creative power, they form inorganic masses; and, when the vital are added to and control the physical forces, organic, living beings result.

Atoms are never in absolute contact. Even in gold the solid material particles must be as much less than the interstices between them, as are the planets than the intervening celestial spaces. And as the plenetary orbs can move freely, incessantly, and simultaneously on their axes, in their orbits around the sun, and with that luminary towards a central point in the celestial vault; so, the atoms of even the most compact mass can move freely in their inter-atomic spaces, in obedience to the impulses of the ever antagonistic forces, which, struggling for the ascendancy, prevent the possibility of equilibrium or *rest.*

As already stated, our purpose is to show that in matter there is no *rest;* that absolute cessation of motion, in even a single atom, has never occurred; and that ceaseless activity is characteristic of each particle, as well as of each celestial orb of God's material creation. Solemn thought —instructive truth! How impressively does it admonish us, as immortal spirits, to obey the injunction, "whatsoever thy hand findeth to do, do it with thy might;" not simply because "the hand of the diligent maketh rich," and "shall bear rule;" but because "the soul of the diligent is made fat," if "fervent in spirit, serving the Lord." The activity of nature is a grand illustration of the sin of slothfulness; and we cannot conceive of a more dismal doom,—a blacker hell,—than the confinement, as Dr. John Breckenridge once described it, of a concious being, in some remote point of space, in a state of absolute, hopeless, eternal stillness!

That not a particle of matter has ever ceased to be is obvious. Matter is inert, passive. Infinite power called it into being, and the same power only can annihilate it.—Besides, created by infinite wisdom, it was designed for purposes commensurate with time; for its annihilation, at any period, however remote, would imply a failure in ability or wisdom to employ it for the accomplishment of a benevolent purpose.

Nor, for the same reasons, can any material atom, however minute, be inactive, useless for an instant. Ceaselessly it must obey its Creator's will. The instant one purpose of its being is accomplished, it enters on the discharge of another. But it is not our purpose to dwell on the metaphysical and moral arguments, which bear directly on this subject. Our arguments must be deduced from physical science; and enough has been said to evince the consistency of the proposition, that not an atom is ever still, with the sublime motions of creation, the ever changing condition of the earth, and, above all, with the attributes of the Creator.

It is important to remember that, in matter, there is never any tardiness. Of this truth every experiment in a Laboratory, as well as every process in the nutritition of animals, is an illustration. In a mixture of oxygen and hydrogen gases, consisting of myriads of atoms, each is ready;

and, yielding to the first impulse of flame or the electric spark, all unite with explosive violence, and water results. So, in the circulation of the blood through the countless ramifications of the capillary vessels, each atom that has performed its function, in any one of the numerous organs of the body, even in solid bone, obeys promptly the impulse to depart, and another from the blood takes its place. All masses, then, how large or small soever they may be, whether planets or particles of dust, oceans or drops of water, quadrupeds or animalcules, are made up of ultimate atoms, few in kind, definite in size, indivisible, not in contact, indestructible, passive or ready to obey any impulse; and each is enveloped in an atmosphere of opposing, antagonistic forces acting upon it. Such is the constitution of matter. Some of the forces acting ceaselessly on its particles are known. Such are gravitation, cohesion, chemical affinity, heat, light, electricity, and sometimes vitality. Matter can be released from the influence of vital force; but though human genius delights in wrestling with difficulties, it has failed signally in all efforts to wrest even one atom from the grasp of any one of the physical forces. And numerous phenomena, not referable to any known power, indicate the existence of others, which produce effects in ways still mysterious and inexplicable, though the progress of discovery has been so rapid, that we may hope they, too, will be ultimately ascertained. This, however, is not necessary to the complete elucidation of the proposition in hand. Nor is it of any consequence whether the enumerated known forces differ merely in modes of action, and are, as some maintain, the same subtle principle—the same power—modified by different circumstances. The effects are, on either supposition, the same; and to produce *rest*, these different forces, or modes of action of the same force, must equilibrate each other; for it is obvious that any, even the slightest disturbance of equilibrium, in the various opposing impulses acting on an atom, must cause in it a corresponding oscillation or departure from a state of *rest*.

Is such a state of equilibrium compatible with the incessant action of so many inconceivably great antagonistic forces, each ever present, and each struggling for the ascendancy? This is not speculation. All science demonstrates that not each mass merely, but each atom, also, is

ceaselessly under the influence of all the physical forces,—gravitation, cohesion, affinity, electricity, heat, and others—that these forces are antagonistic, heat, for example, contending against cohesion, and electricity against affinity; and that all the diversities in form and other properties of matter, result from the effects of these forces, one ever and anon gaining and another losing the ascendancy, though neither is destroyed. Every school-boy knows heat enough may be squeezed out of a pint of cold air to make a pound of iron red hot; yet so much is left to contend with cohesion, that the air is not rendered either liquid or solid. When, however, a similar quantity of heat is extracted from carbonic acid and other gases, they are liquified, and, in some cases, solidified, showing that cohesion is active in gaseous particles. The same is true of all the other forces. They are ever present and active, though they may seem to be dormant.

Nor must we forget, that when seemingly dormant, they may be freely developed, by an apparently slight external excitement. A certain mineral, brushed gently with a feather, manifests electric excitement, and emits phosphorescent light. A compound of nitrogen explodes violently when touched with phosphorus; and an iodide of mercury, when merely scratched with a pin point, changes in color from yellow to rich vermilion. And any cause that affects one of these forces invariably augments or diminishes one or more of the others. It would be easy to multiply examples; but enough has been said to evince the truth, that the relative strength of numerous forces, constantly acting on each atom, may be changed by conditions so various and slight, as to preclude the idea of such a balance of power, as is necessary to bring to a state of *rest*, particles having, in all cases, ample space to move in.

And, by rest, we mean absolute cessation of motion; for motion often eludes and cannot be measured by vision. Can we see the motions of the particles which unite an external wound? The result we see; but the motions of the myriads of particles, which marshall themselves in symmetrical order, according to fixed vital laws, in the filaments of the nerves, blood-vessels, muscle and skin, of the renewed flesh, defy the highest power of the best microscope.

We will illustrate a little more fully the reality of invisible motions; and, to do it, attention will be directed to a substance in which all the agencies—gravitation, cohesion, chemical affinity, electricity, heat, light and vitality—are in full activity. We know no experiment that has interested us more, or that has excited a profounder sense of awe than this. Examine, in a glass of water, a large animalcule barely visible to the naked eye. It seems to be a white speck, moving in the water. Catch it in the end of a small glass tube, transfer it to the crushing box of a good microscope, and confine it on its side in a drop of water. In a clear light, though its body is confined, the motions of its parts—as the head, eyes and organs of motion—are distinctly seen through the instrument. These voluntary motions are what we expect. They are of a kind to which we are accustomed. So of the involuntary motions of its lungs and other internal organs. In addition to this, however, a far more instructive scene presents itself. In the whole of the illuminated body of the little transparent creature, every particle is seen to be in motion. Nor is this pervading motion a mere momentary shudder. It may be seen for hours; and if the animal be then released from confinement, it swims as joyously as ever.—Watch it when it pauses on its career, and the same tremulous motions of the particles of its body will be seen to pervade its whole frame. These motions are visible, but can we believe we see all that occur in its body? And what is the cause of this natural tremor of organic particles? To answer this question, we must remember that no animal can live an instant without the conjoint stimuli of vitality, heat, electricity, chemical affinity and gravitation. Is not the tremor, in the entire substance of the animalcule, the result of the struggle between these agencies? The same elementary motion, doubtless, pervades the system of every living being. Truly "in the midst of life we are in death." Death is but the cessation of vital motion in an organism. And can we suppose the overthrow of vitality, in any case, causes harmony between the other forces? All science is opposed to the thought.

Let us, now, examine briefly some of the laws or modes of action of the known forces, which must prevent such a balance of power, as is essential to rest, from being perfect-

ly attained, for an instant,—which must indeed render it impossible. And, in prosecuting this investigation, we must bear in mind the truth, that to preserve any one atom of a mass in a state of even relative rest, each and every atom of that mass must be perfectly suspended between balanced forces: for a disturbance of any one point must propagate itself through all others, momentarily at least, precisely as when a voltaic circuit is brought in contact with one end of a telegraphic wire, the effect is propagated through the wire, quite to the other end.

We will begin with gravitation. We are apt to regard it as a force that attracts and influences masses only. We are wont to view it in reference to the vast area of its action; and to see in it a power spanning all space; holding our revolving, wheeling, rocking earth by a cord that cannot be sundered; binding planet to planet; chaining system to system; and linking together, in their motions, the myriads of worlds, that adorn the robe of the Infinite. Yet, it influences each mass in direct proportion to the number and weight of its atoms. It guides and controls masses not as such, but as congeries of atoms. True, by its laws, the astronomer not only proves that suns and stars are solid bodies; poises one against another; and calculates accurately the weight of each; but ascertains the cause of the slightest disturbance of the general balance of the gravitating force. Thus, a slight trembling was observed in Uranus in a particular part of its orbit; and this led Adams in England, and Le Verrier in France, to determine the exact place of an unknown planet; and, to the honor of these far searching minds, and to the glory of science, the planet Neptune has since been discovered in the very place, which had been designated by rigorous calculation. Hence, say astronomers, "if one of the most remote of those gems of light, which flicker at midnight, in the dark distance of the starry vault, were, by any power, removed from its place, the disturbance of these delicately balanced mysteries, would be felt through all the created systems of worlds." Yea, astronomers assure us, that so completely is all nature locked in the bonds of this infinite power, (gravitation,) that it is "no poetic exaggeration to declare that the blow, which rends *any earthly mass*, is conveyed, by successive impulses, to every one of the myriads

of orbs, which are even too remote for the reach of telescopic vision."

Now, in these statements, all astronomers cannot possibly be mistaken. Yet, if what they tell us is true, and if, as they demonstrate, gravitation links together, not masses as such, but atoms into masses, masses into planets, planets into systems, and these into the harmonious universe, what must be the effect of the myriads of disturbances or oscillations, like that to which we have alluded in Uranus? Must not all atoms be kept in a state of extreme tension, and of consequent tremulous motion? Yea more! if the blow which rends any *earthly* mass, is conveyed by successive impulses to every one of the most distant orbs, what must be the effect, on the universe, of even the exertions of force in this little planet? Think not merely of volcanic eruptions, rocking earthquakes, heaving subterraneous forces, exploding meteors, falling mountains and desolating avalanches; but of rocky masses rent asunder by ice, bursts of electric fluid in thunder storms, discharges of artillery, and the thousand ways by which at least a limited portion of the earth's solid surface is made to vibrate perceptibly; and you may form a conception of the myriads of impulses, momentarily conveyed from particle to particle, through the solid interior of this planet, and from it to other worlds.—Yet, to prove that not a world, not an atom is at rest, we might safely limit our view to earthquakes alone; for Humboldt tells us, in his Cosmos, that "could we obtain daily news of the state of the earth's crust, we should, in all probability, become convinced, that some point or other of its surface is ceaselessly shaken by earthquakes."

And what are such exertions of power—such departures from a state of quiescence—but overthrows, temporarily, but on a grand scale, of the balance of forces? And can we suppose such disturbances as volcanoes and earthquakes are peculiar to this planet? The surface of the moon exhibits distinctly, under a telescope, more than 1,000 volcanic craters, and some are 25,000 feet in height, as many feet in depth, and 150 miles in circumference. And can we believe all the other planetary bodies are in profound repose? Suppose them all, numerous as they are seen to be in the blue vault of heaven, and especially in the milky way, to be rent by disturbances like those which

shake our earth; and what must be the effect, through the mysterious, ever struggling, ever recuperative force of gravitation, on the atoms of each revolving, pendulating orb?

We have an apt illustration of this part of the subject in our atmosphere. It is an immense ærial ocean, at the bottom of which we move, and breathe, and hear. So obvious are the effects of moving bodies, breathing animals, winds, heat, electricity, and other forces that constantly stir its elastic particles, that no one can believe its atoms are ever still. Leaving out of view all these forces, let us confine our attention to the phenomena of sound. And what is sound but the effect of vibratory motion, transmitted from particle to particle through air? And were the air subject to no other cause of motion, would not the myriads of sounds, ever rolling from earth's surface, keep each ærial particle ceaselessly pulsating? If so, must not all the causes of motion united, have a similar effect on the atoms of all ærial oceans of matter in the universe, including comets and nebulæ?

But some may object to this illustration by saying ærial masses are elastic, while the great bulk of the earth and other planets consists of solids and fluids. And are not liquids and solids, metals especially, better conductors of sound than air? Franklin first proved, by numerous experiments, that water transmits sound more rapidly and distinctly than air; and hence marine animals, that hear well under water, are deaf and appear stupid when their ears are in air. Biot proved the same, though in a much greater degree, of metals. When one end of a long series of united metallic pipes was struck, an ear placed at the other end heard two sounds, the first and loudest being transmitted through the metal, and the second through the air. Do, then, the causes of sound shake the particles of the solid earth to a greater extent than those of air? Certainly they do; and hence animals, as the mole, which burrow in the earth, have no external ear, yet hear the slightest sound. And do the vibrations of each sound pulsate through the whole ærial ocean? What can prevent it? The balance of forces being disturbed in one part, must not every atom, however remote, change its position? The explosions of a volcanic eruption have been heard, distinctly, 970 miles, showing that the particles of air were

so convulsed, throughout a space near 2000 miles in diameter, as to affect the human nerve of sound. Had it been possible to place a sound human organ of hearing at the centre of the earth, would not the awful explosions of that volcano have been heard even there?

In illustration of the propagation of motion from particle to particle, through immense masses, let us take another familiar instance. Shakspeare says, somewhere, a pebble dropped into a lake shakes all the water in it. And who can doubt, that the launch of a war-steamer, or the plunge of each porpoise, moves every atom in the Atlantic? The force of gravitation being disturbed in one part, where can the necessity for readjustment cease?

In considering the effects of disturbances of gravity by volcanos and earthquakes, we must remember what Daubeny and Humboldt tell us, that, in such convulsions, there are generally three simultaneous motions—one upwards, another horizontal, and a third rotary. Hence the curious fact mentioned by Humboldt, in his description of the overthrow of the town of Riobamba, in 1797, when the bodies of many of the inhabitants were found to have been hurled several hundred feet upwards, but not vertically upwards, for the horizontal force carried them to the top of the high hill, Cullca, between which and the town flowed the river Lican; and the furniture of one house was, in many cases, found under the ruins of another.

But gravitation is not the only force acting on the planetary bodies. Were it, for a moment, unrestrained by antagonistic powers, all the planets of the solar system would rush to their centre, the sun, and with it towards some other greater centre or centres of attraction. In the consequent wreck of worlds, whether there would be one or several centres; in what directions those centres lie; and how remote they are, are problems which finite intelligence can never solve.

One of the antagonistic powers is the centrifugal force, which causes the planets to revolve in their orbits around the sun, with different degrees of velocity. The earth travels in its orbit 68,000 miles in an hour, or 630,000,000 miles in a year—a velocity sufficient of itself to rend the hardest rocks; and were the impulse to separation imparted by it to the portions of the revolving mass unrestrained,

for an instant, by gravitation and other forces, our planet would be shivered and scattered through space, in heated, glowing fragments, like a shower of shooting stars. There is, then, an incessant struggle between gravitation and the centrifugal force, each spanning the universe, one inducing a tendency in all material atoms to fly asunder, the other chaining them together in masses. In the grasp of such contending forces, worlds oscillate continually; and must not the atoms of those worlds tumble incessantly?

In addition to that in its orbit, the earth has at least three other kinds of motion, viz: a diurnal revolution on its axis, at the rate of 1000 miles an hour; the precession of the equinoxes; and the nutation of its axis. The diurnal revolution was ascribed by Laplace to the centrifugal force; and he calculated the exact angle or degree of obliquity at which the force struck the planet, in order to produce both the orbital and axial motions. The precession of the equinoxes may also result from the same force, counteracted by the sun and moon, acting obliquely on that accumulation of matter under the equator, which gives the earth its oblate spheroidal form. These motions, however, and the nutation of its axis, may be produced by other unknown forces. However this may be, all the planetary bodies, that are within the sphere of telescopic vision and rigid mathematical calculation, exhibit the same kinds of motion, and are, therefore, subject to the same forces, known and unknown; and hence, the effects of these forces on the matter of the earth may be safely predicated of all the heavenly bodies. And we know that the earth, "rocking regularly upon a point, round which it performs its diurnal revolution, progresses onward with incredible speed in its orbit, and also accompanies the sun in its motion towards a point in the starry vault, at the rate of 33,500,000 miles in a year. "Like some huge wheeling top, in tremulous gyration upon the deck of some vast ærial ship, itself gliding rapidly through space," is the earth performing its part in the great law of motion. And how can such motions fail to influence materially the condition of each atom? Constantly impelled in opposite directions, each atom, like the orb of which it forms a part, must oscillate, rock, gyrate and revolve, for we must remember that atoms are never in absolute contact, that the interstices between them

are proportionally as large as the inter-planetary spaces, and, therefore, that all have ample inter-atomic space, in which to perform their motions. Thus free to move, all are subjected to the influence of opposing forces. These are, in the aggregate, delicately and securely balanced; but, ever and anon, one temporarily, slightly gains the ascendency, as when the earth is at different distances from the sun, or is suddenly approached by a comet. In this way must not all atoms be kept vibrating? "The spring is brought to the highest state of tension—one tremor more, and the balance would be destroyed." It is a wonderful display of omnipotent power and infinite wisdom, ever active in every part of the universe.

Let us now consider, briefly, the action of other antagonistic forces; and, for the sake of clearness, we will limit our view as much as possible to this planet; for what is true of its particles may, we have seen, be safely predicated of the whole great machine—the stellar system of the universe. And we will first examine cohesion and crystallographic attraction.

Cohesion is so similar in many respects to gravitation, that some philosophers are inclined to regard them as modifications of the same force. Many phenomena are, however, irreconcilable with this view, and the experiments of Prof. Plateau serve to prove, that they are independent forces, for drops of oil, wholly withdrawn, in a most ingenious way, from the influence of gravity, assumed, not the spheroidal flattened form of masses under the conjoint effects of gravitation and cohesion, considered as modifications of the same force, but perfectly spherical shapes, which could only have resulted from some distinct power, acting equally in all directions from the centre of particles possessed of perfect freedom of motion. There is, then, a peculiar, distinct force, that unites atoms, simple or compound, into masses. It acts at insensible distances only; for if a pipe stem be snapped, or a tumbler fractured, we cannot reunite the parts by bringing them into apparent contact. The fragments weigh, however, as much as did the pipe or tumbler; and hence, a cause that subverts cohesion does not diminish gravitation. This force resists alike the tendency of gravitation to unite all matter into one mass around a common centre, and that of the centri-

fugal force to shatter masses into scattered fragments. Like both, it acts on all kinds and forms of matter; for as soon as its special antagonist, heat, is subdued, in any way, in gases, it collects their atoms into liquid drops, and finally, if unresisted, into solid globules. Its sole office seems to be the aggregation of atoms into spherules, without regard to number, relative position, or permanent arrangement. It is ever busy, gathering atoms of every kind into plastic aggregates, to be moulded into other forms by those active forces, crystallogeny, chemical affinity, and vitality. Nor is cohesion an inconsiderable force. Its sphere of action is limited, but within that shere it often attains great power. Though it may be so modified by other agencies as to permit matter to assume various degrees of either the solid, liquid, or gaseous state, it sometimes acquires such intense energy, as seemingly to defy all exertions of other forces. Thus, titanium resists, successfully, under all ordinary conditions, the efforts of heat, electricity and chemical affinity, to reduce it to the liquid state; and an iron wire, 1-36 of an inch in diameter, sustains a weight of 60 pounds. We feel its power, not merely when we attempt to rend rocks or snap metals, but when we break threads of cotton, flax or silk.

In its activity, it strives ceaselessly to bring all atoms under its domain, and to lock them up in unyielding globules. Were atoms to escape, momentarily, from the grasp and influence of other forces, cohesion would bind them fast in amorphous, motionless solids.

This tendency of cohesion is curiously modified, though not absolutely resisted, by crystallographic attraction. In this force, Nature reveals many of her most wonderful secrets, and permits us to behold, not merely the results of her operations, but the processes themselves. In studying these processes in our laboratories, we can examine multitudes of substances in the act of passing from the liquid or gaseous to the solid state; and, in all cases, the instant before they congeal or come fully within the sphere of the cohesive grasp, their atoms evidently obey a new impulse; and, arranging themselves according to certain laws of symmetry, their aggregation gives rise, not to amorphous solids, but to regular geometric forms. These forms of crystals are almost as characteristic of mineral species, as

the forms that occur in the world of organization are of the species of living beings. Yet, in these beautiful crystalline solids, atoms are not in contact; and the symmetry of their figures indicates clearly, that the force impresses on each atom a directive tendency, like the polarity of a magnet. The polar points of attraction and repulsion cannot cease to act as long as cohesion keeps them in close proximity. Indeed, these attractive and repulsive points must keep the atoms suspended in the interstitial spaces, trembling under the influence of gravitation impelling them towards a centre; of the centrifugal force, tending to scatter them; of cohesion, laboring to bind them down in irregular solids; of chemical affinity, drawing them into other combinations; of heat, exerting its repulsive energy to dissipate them in vapor; of magnetism and electricity, according to the refined observations of Plucker and Faraday, impelling them, sometimes in the direction of the magnetic meridian, and at other times at right angles to that line; of light, wooing them into certain optic axes for the display of the marvellous phenomena of polarization; and perhaps of other forces equally potent, such as those which give rise to isomerism, dimorphism, isomorphism, allotropism, eremacausis, actinism, and other less marked phenomena.

The vital principle adorns the surface of the earth with endlessly diversified forms of animal and vegetable life, causing changes in matter on a scale of magnitude that defies conception. In the deep rocky recesses of the earth vitality ceases; yet, even there, the crystallogenic force, like a creative spirit, pursues its never ending task of effecting changes in the forms of matter, and of modelling sparkling gems or treasuring up useful substances, in dark caverns, damp crevices, and even in solid rock.

To form any idea of the grandeur of the scale on which this agency has acted, in all the inconceivably protracted geologic periods in the earth's eventful existence as a planet, you must examine attentively the rocky basement of the everlasting hills. Begin with the unstratified masses, that form the unstable foundation, (for it is constantly shattered by earthquakes or melted by volcanic fires.) In that changing foundation, you will find granite and its associates—once melted, perhaps gaseous matter—now made up

of crystals and crystalline grains. On these lie gneiss and other stratified rocks, sometimes at least twenty miles in thickness, and which were deposited in ancient oceans as comminuted fragments torn or worn from granitic shores. These, too, have been remodelled by this active force, and the sand, mud and pebbles of which they consisted, when first deposited, have been thoroughly changed, and they are now richly laden with light refracting crystals, except at their upturned edges near the surface, where, by the chemical effects of air, and moisture, and other substances, they have rotted into beds of clay, often more than 100 feet thick. On these non-fossiliferous rocks lie the fossiliferous strata, ten miles thick, and more wonderful than all below them. In these, too, is found abundant evidence of the activity of this plastic force, in restoring to form and comeliness the debris of dilapidated continents. But this is not all. Mountain chains, in all countries, composed in a great degree of the remains of animals and plants, have been moulded into crystalline, stoney catacombs, without effacing the most delicate lines of organic structure. Even in the southern part of our own State are enormous beds of rock, filled throughout with marine shells. These shells, when deposited on ocean's bed by races now extinct, must have consisted chiefly of carbonate of lime; but this substance has been, in most cases, removed by chemical processes, and its place supplied by crystalline silex. The changes, that have occurred in the organic structures of such rocks, may be familiarly illustrated by supposing a piece of jewelry "to be taken to pieces, atom by atom, the expert mechanist so skilfully substituting a particle of brass for each one of gold displaced, that the removal of the precious metal could not be detected by mere inspection of the external form." The fossil shells, in such cases, are unchanged in shape, but their original substance has been completely removed and replaced. Indeed, in some instances, the work was arrested before the process of chemical and crystalline substitution was completed; for though a part of some shells is silex, other parts retain the carbonate of lime which the animal secreted; but even that, when broken, shows that the atoms have been in motion, for it exhibits within a crystalline arrangement. Nor is this all. We frequently find in rocks pleasing evi-

dence of curious changes of another kind. As animals and plants grow, generate, die, and decay, thereby displaying Divine wisdom and goodness, while they beautify the surface of the earth, and keep up endless motions and changes in matter; so, in the dark recesses below, crystals are formed by accretion. They increase in size till they attain what may be regarded as their maturity, and then, owing to some change of the conditions in which they were formed, they are decomposed and removed by chemical solution, and their place is taken by other crystalized matter, without a change in form. In this way one mineral is made to imitate the crystalline form of another; and so numerous are the evidences of these curious changes in the solid crystals of solid rocks, that every cabinet of minerals contains these skeleton crystals of quartz, oxide of iron, oxide of tin, copper pyrites, and other minerals, called *pseudomorphs.*

Liquid and gaseous bodies cannot be modeled into symmetrical forms by this potent architect, because, probably, their atoms are too restlessly in motion, performing other functions; but as soon as solid matter is precipitated on the beds of oceans, resulting from the spoils of disintegrated crystalline rocks, or is poured out through volcanic vents from deep seated masses of melted granite, so as to be once more in danger of being chained down by cohesion, its atoms are seized by this resistless agency, and are made to labor in the reproduction of forms of utility and beauty.

But persons who are unaccustomed to the close and scrutinizing examination of nature's processes, may be skeptical when told of motions, attended with a total change of form, in matter apparently solid, unyielding, and still. They may be incredulous when informed, that molecular forces often effect re-arrangements of particles in the most compact inorganic bodies—re-arrangements which are proved by sensible changes in properties. They will admit that the particles of the most compact parts of the bones of animals and of the woody fibre of plants, are ever changing, because they know the body of each living being is a vortex, into the current of which particles are continually entering, and from which they are continually departing, so that the form of each is obviously more important than its substance, yet they habitually attach the

idea of fixedness and durability to inorganic solids. This is a great mistake. Truly did the inspired writer of Ecclesiastes say, "all things are full of labor, man cannot utter it;" for calomel, when first sublimed, is a transparent solid, which slowly becomes opaque, owing to a rearrangement of its atoms. Phosphorus, heated to 150° F. and suddenly cooled, is a black solid, but its flesh-colored translucency is soon restored. Sulphur may be obtained in the form of a waxy solid, capable of receiving and retaining the impressions of seals, but in a few days it resumes its crystalline texture and loses its plasticity. Sulphate of Nickel crystalizes in six-sided prisms, which change to octahedrons, without liquifying, as soon as they are exposed to the sun's rays. Even well annealed copper wire has been found to lose its tenacity, after a series of years, and to consist then of minute cubic crystals. A multitude of other facts, which could easily be specified, demonstrate the mobility of atoms in the densest solids. And, though the process of crystalization is facilitated by the passage of matter from a liquid or gaseous to the solid state, amorphous solids can assume a crystaline structure. The particles of solids can and do move.

Indeed, the most striking proof that endless change, incessant motion, ceaseless activity of every particle of matter, is one of the laws of creative wisdom, is found in the fact, that the very agency employed in creating a structure, is most active, when that structure is finished, in reducing it to its primitive condition. Thus, the power, that forms crystaline rocks, is often more active than chemical affinity, electric currents, or other force, in reducing them to atoms; for when water percolates into cavities of rocks and pores of minerals, its congelation and crystallization are attended with so resistless an expansive force, that soils crumble, minerals disintegrate, and rocks split with explosive violence. It is to the crystallization and consequent expansion of water, more than to any single agency, that we must ascribe the gradual destruction of existing rocks; and many geologic phenomena, such as the deposits called drift, indicate the former existence of protracted periods, when much of the globe was enveloped in ice. Hence, probably, the same force has always been active in destroying its own works. And the same may be said of

each of the other forces. Nor is it at all strange, for not one of them acts uniformly under all circumstances. Each is modified by any change in the conditions under which it acts. And as so many are ceaselessly at work altering the conditions of all, can the result be other than ceaseless change? Is such a state of things compatible with our idea of a balance of forces? And if a balance should occur in one place sufficient to produce rest, might it not occur in others, more and more easily, till all motion would cease? Is the supposition—is the absolute rest of an atom—consistent with scripture representations of the Omnipresence, Omniscience, Omnipotence, and constant superintendence of a God, who numbers the hairs of our heads? "All things are full of labor, man cannot utter it!!"

If, then, we reflect on the activity of the crystallogenic force—on the grandeur of its displays of power, the extent of its domain, and the beauty of its structures, it is not surprising that the "Oriental story-teller," ignorant of the God of the Bible, "makes the interior of the solid earth a place of rare beauty—a great temple studded with lustrous gems, in which reside the spiritual governors of the inorganic world."

In pursuance of our design, we proceed, now, to consider briefly some of the effects of the more subtile agencies, which produce every thing that is beautiful and joyous in this world. A volume could easily be written on the subject, and therefore, to avoid being tedious, we will confine our illustrations of the ceaseless activity of matter to the more obvious effects of these agencies.

What is their nature, is a question still open for the investigation of that genius, which finds its enjoyment in struggling with the secrets of nature. "Science, with the wand of induction, interrogates; but the only answer is the manifestation of power in startling effects." Slight friction ignites a match, and causes are set at work, in an instant, capable, if unresisted for a few hours, of dissipating in vapor, smoke, and gases, a cottage, a palace, or a city. What is the nature of these causes? Perhaps the best description of them is that of Newton, slightly altered in the verbiage. "They consist in minute vibratory motions in the particles of bodies, and this motion is communicated through an apparent vacuum, by the undulations of a very subtile elastic medium."

The friction of the match subverts the apparent, not real, balance of forces in the causes of change; for the match, before ignition, is not inactive. Held in air, at night, it glows and smells of sulphur and phosphorus. Ignited, we see the light, feel the heat, perceive the wonderful energy of chemical change, and can readily demonstrate the rapid propagation of electric force and magnetic influence. All is motion. Matter rapidly assumes new forms. The burning city is in substance the same, though to us it is a scene of wild commotion in Nature's unchained powers. The heavens are illuminated, black clouds congregate, winds howl, lightnings flash, and torrents of rain descend.

Yet, reflect a moment. How insignificant is this scene, compared with what is ceaselessly in progress in the whole interior of the planet! A mile in depth below this or any spot on its surface, the rocks are hot enough to boil water; and as the heat rapidly increases with the depth, the pent up powers, increasing each others intensity, in their antagonistic struggles, shake the globe with earthquake tremors, pour deluges of lava through one or other of three hundred volcanoes, rend the air with chemical and electric explosions, and startle mankind by mysterious displays of magnetic storms, aurora borealis, and other phenomena. Calorific, electric, magnetic, and chemical phenomena, indicate clearly that all within the crust of the earth is in commotion, and geologic science demonstrates that such has been the case since the world began. And how legibly does the expert geologist read, in the crust itself, evidence of ceaseless flow of currents of these resistless agencies! Each atom seems to say, *no rest.*

But behold the sun, a great fountain of all these forces; yea, myriads of suns in the apparent stillness of night, each millions of times larger than our earth; each ever pouring floods of influence on all parts of God's creation; and that influence consisting of a marvelous union of heating, illuminating, electric, magnetic and chemical power.

A sun-ray is a magic thing. Its heat, resisting cohesion, controls by expansion the volume of all kinds of matter. Its light, by altering molecular arrangements, spreads over nature most lovely tints. Its electricity is sent round and through the earth to perform its wondrous work of giving

structure to rocks, form to minerals, and position to metallic ores. Its magnetism makes the earth a great loadstone, thereby binding all its parts together, each with a directive tendency, as when a magnet holds in its embrace a mass of tacks or nails. Its chemical influence modifies endlessly the composition and properties of matter. "On the sun-ray depends the sweetness of the flower, which lifts its head to the morning radiance, and the vivacity of the bird, which warbles soft melody at twilight." The morning sun-beam falls on the mountain top, and its radiating influence is instantly felt to earth's centre.

To make this part of the subject more intelligible, we refer the reader to the *solar spectrum*, which all have seen, when a beam from the sun, passing through a small orifice in the window shutter of a dark room, is intercepted by a transparent glass prism. The beam, by unequal refraction, is decomposed, and the separated rays or forces are caught on a scren. In the centre of the scren are represented the colored rays. These give rise to all the phenomena of color and vision. Below the illuminating rays, where scarce a trace of light can be detected, is a space in which various heating rays, as different from each other as are the colored rays, produce a variety of curious calorific effects, expanding bodies and setting in motion most manifest currents of electricity. Above the spectrum is another space, in which the poetic dreams of the ancients, the incantation scenes of the dark ages, and the magic mirrors of eastern fable, have been surpassed by scientific realities. In that space, actinic rays produce chemical changes, which we still witness with admiration in Daguerreotype pictures of endeared friends and lovely scenes—pictures, which the artist's pencil cannot approach in accuracy. These impressions are made, not on polished silver plates only, but on all bodies whatever; and the discoveries of Daguerre, Talbot, Herschel, Draper, and others, in the various branches of Photography, Heliography, and Thermography, demonstrate, beyond all doubt, the truth first pronounced by Niepce—a truth not inferior in importance to Newton's law of gravitation—"that no substance can be exposed to the sun's rays without undergoing a chemical change."

Nor is the change or motion in material particles limited

to daylight, for we have seen that these actinic rays are not luminous. They are absorbed by all bodies—granite, sand, metals, ores, liquids, gases, plants, and animals.—During this absorption, all bodies experience active molecular changes; and Sir J. Herschel has proved, in his papers on Photographic processes and on Parathermic rays, that all bodies, which undergo molecular changes in daylight, have the wonderful power of gradual restoration to their original condition during the darkness of night. Daguerreotype plates, metal tablets, and photogenic papers, on which sun-drawn images are not fixed, as the artist terms it, prove this in a most convincing manner. Thus, if paper be prepared with iodide of platinium, and impressed by sunshine with an image of a flower or key, and then placed in darkness, the image is effaced in a few moments, and the paper is restored to its original sensitiveness. How strangely does this show a necessity for the alternation of day and night; and how wonderfully may the comparative permanence of rocks and soils, and the health of animals and plants, depend on this mysterious law!

So strikingly are these forces—these actinic, chemical agencies of light—modified by circumstances, that by one ingenious contrivance an artist can take a perfect Daguerreotype copy of an object placed in darkness, while by another modification of his apparatus, no image can be obtained from an object illuminated by the strongest light. Indeed, the sun itself, setting behind an atmosphere which gives it a pale red or rich yellow disc, cannot impress its image on the most delicate plate, because the actinic rays are absorbed by such an atmosphere. In this way, the different states of the atmosphere cause the sun's influence to vary on consecutive days, and give rise to those differences in its heating effects, in spring, summer, and autumn, with which experience makes us familiar, though till recently we knew not the cause of the difference.

Time forbids my dwelling longer on the multiplied phenomena of molecular motion, resulting from the modifications of active illuminating, calorific rays, found in a single sun-beam.

When we attempt to form a conception of the aggregate amount of change and motion, effected silently by the

solar and astral flood of influence shed on the crust of the earth, during each diurnal revolution, the mind is lost in admiration. And as the planet wheels in its different motions, with inconceivable rapidity, presenting, at each instant, different portions of its surface to the sun, the balance of forces is ever varying, and currents of force, now increasing, now diminishing, are unceasingly traversing the earth in different directions, and stirring the atoms of which it consists. Nor must we forget that these impulses on the surface are met by similar, though feebler ones, from the heated interior. We must remember, too, that in many cases, as Herschel discovered, when action is once begun by even a momentary exposure to sunshine, "it goes on slowly working its effect even in darkness, apparently without other limit than is afforded by the supply of ingredients present." Thus, when any of the salts of gold are spread on paper, ribbon, or other organic substance, and exposed for an instant to the sun, decomposition begins, and progresses slowly even in the dark, till all the gold is reduced to the metallic state.

Other subtile agencies are at work around us, producing changes on a grand scale, yet of such a mysterious kind, that they are as little seen, though as real, as the animalcules of the microscopic world. I can merely glance at a class of discoveries made by Moser, Draper, Hunt, Faraday, Brewster, Riechenbach, Gregory, and others, which show that we have a certain glimpse of fields of research, in which will be made full developments, not only of powers already slightly known to us, but of other higher and more subtile influences, which, though now dreamed of, are not yet known certainly in our philosophy.

What an immense advance has been made in chemistry, electricity and zoology, since Davy, Wollaston and Cuvier died, a few years ago!

But I proceed to the enumeration of a few facts to show, that unknown forces *are at work* around us, which consist of radiations capable of effecting astonishing changes in matter.

Hunt proved that chemical action is begun and decomposition produced by the mere juxtaposition of bodies; for when he suspended an amalgamated plate of copper over iodide of silver spread on glass, the iodide was decomposed and the silver reduced to the metallic state.

Moser ascertained that various bodies, by some unknown radiating influence, impress their images on each other. Thus, an engraved plate, or a cylinder of wood, placed near a polished metal, will impart to the latter an image, which may be so distinctly evolved, as to show even the fibres of the cylinder of wood.

So, a printed page, suspended facing a polished metallic plate, imparts to the latter, in a few days, an impression of each letter, which is wholly dormant and invisible, but which may be developed by vapor, oxidation, or other means, and made distinctly legible. The black letters radiate heat more readily than the white paper, and this difference in the power of calorific radiation may be the cause of the image.

Any bodies, which differ in their electrical states, act on each other. Thus, arsenic, which is negative, impresses its image on positive copper.

Indeed, we may lay down as a scientific principle, clearly proved by facts, though the cause or causes of the facts may not be fully known, that any bodies, in proximity to each other, which differ either in their chemical relations, or in their power of radiating heat, or in their electric state, or in their magnetic condition, impress dormant images on each other, which are, in many cases, permanent, and which may, by various means, be evolved.

And do *we*, then, through these mysterious radiations of influences, which are capable of effecting even visible changes in matter, leave on the objects about us an ineffaceable impress of our most secret actions and softest whispers? Are all recorded, thus, against us? Are the objects around us, as Dr. Hamilton says in his sermon on Retribution, "time's leaves, each catching and retaining a history—daguerreotyped, fixed forever—borne *on* and ON to the great archives of eternity, there laid up safe in the repository of the Almighty, and constituting '*the books*' out *of* which men shall be judged?" Do we see in these *phenomena*, as the learned and pious Babbage thinks, "established laws, by which every criminal is irrevocably chained to the testimony of his crime." Do the acts of murderers, the oaths of the profane, the looks of gamblers, and the arts of seducers, record themselves on walls, rocks, trees—all objects in their vicinity? Is this what is meant

by those dark passages of Scripture: "There is nothing hid that shall not be manifested;" and, "What ye have spoken in darkness shall be manifested in the light?"

Say not that so many motions must obliterate one another. All things are possible with God. Each sound vibrates through the whole air, leaving the atoms arranged as they never were before. Each pebble dropped in the ocean moves every particle of water in it, and gives each a new and distinct position. No two leaves in the forest are identical. No two human countenances are precisely alike. Individual distinctness is characteristic of all God's works. Each leaf—each countenance—is the result of a peculiar combination of actions; and may not the acts and words of each of us so impress matter as to form, by their combination, a legible record of the life and character of each?

This is not more strange than the fact that geology enables us to read in the rocks a marvellously clear history of whole races of plants and animals, which were created successively, during numerous inconceivable protracted periods anterior to the human era. The strata of the earth are *the* leaves of a faithful and instructive historic record of the beings of past ages; and who can say what evidence may be laid up, by Infinite wisdom and power, in material elements, against that great day, when, endued with higher powers, each individual will be made to read, in imperishable material atoms, the history of every act of his mortal career?

From what has been said, it must be evident, we think, that every particle of matter is unceasingly at work. To this, probably, the first chapter of Ecclesiates refers. The writer states that "the earth abideth *forever*," meaning obviously, not "from everlasting," but from the beginning to the close of the existence of measures of time; and geology shows that as a planet, it has existed in past periods, and probably will exist, (the end of the present state of things being succeeded by "new heavens and a new earth,") during periods so long, that we may literally apply to them the term *forever*. He says, also, "generation succeeds generation," referring, obviously, to unceasing changes in the organic world; that the "sun hasteth to the place where he arose," alluding to the endless revolutions of the heavenly bodies; that the wind, in its "circuits," "whirl-

eth about continually," showing the restless state of the whole atmosphere; and that "the rivers run into the sea, yet the sea is not full; unto the place whence the rivers come, thither they return again," illustrating the vast changes occurring daily in the waters of the earth. The subject of unceasing change in the material universe, being thus fully before his inspired mind, he abruptly says of rocks, sand, all inorganic bodies, what the ignorant may regard as hyperbole, but what physical science has almost demonstrated to be literally true, "all things are full of labor, man cannot utter it."

ARTICLE IV.

AN INQUIRY;—ARE THE WICKED IMMORTAL?

Six Sermons. By George Storrs.

Of the author of these discourses we know nothing except his name. He is no doubt sincere in believing the doctrine here advanced with considerable boldness. Since persons may be sincere, however, in adopting and expressing erroneous sentiments, the chief question in regard to a book presented to the public should not be who is its author, or is he sincere in embracing his published opinions, but whether they are supported by valid authority and indisputable evidence. If the testimony in their favor be strong and cumulative, or light as one of the imponderable agents, the questions that might be raised concerning the author or his sincerity, must be relatively useless and unimportant. Intelligent readers feel a deeper concern for the truth or falsity of the doctrines and opinions of writers, than for their names or the motives which induce them to compose their works and give them to the world.

The author of these sermons commences by bestowing a panegyric on the Athenians, for the respectful and courteous manner in which they listened to the preaching of Paul, on the resurrection of the dead. Although the doctrine was strange and new to them, yet they desired to hear