
II.—THE TENDENCIES OF SCIENCE.

Antiquity of Man. By Sir C. Lyell, F.R.S. London:
Murray. 1863.

*On the Origin of Species by means of Natural Selection,
&c.* By Charles Darwin, M.A., F.R.S., F.L.S., F.G.S.
London: Murray. 1860.

Correlation of Physical Forces. By C. Grove, Esq.

Lectures on Comparative Anatomy. By T. H. Huxley, F.R.S. London: John Churchill and Sons. 1864.

Researches on the Solar Spectrum and the Spectra of the Chemical Elements. By G. Kirchhoff. Translated by H. E. Roscoe, B.A. Cambridge: Macmillan and Co. 1864.

Lectures upon the Science of Language, delivered at the Royal Institution of Great Britain. By Max Müller, M.A. First Series: 3rd Ed. 1862. Second Series: 1864. London: Longmans.

Papers read at the British Association, October, 1864.

WHEN the geologist examines a bed of ancient drift, he observes that the pebbles have their longer diameters all in one direction. They tell him almost as clearly as if they could speak, that a great current of water has anciently passed over them; they indicate the line in which that current must have swept. In like manner the future historian of civilization, when looking back on these present times, will observe the tendencies of thought of all the most eminent thinkers in every department of human knowledge turned in the same direction. He, too, will read here the fact, that some great current of influence—some one powerful law of thought—has been sweeping over the educated mind, bearing all intellectual development on in the line of its own great stream. He will notice that the thinkers are tending everywhere towards the utmost possible unity in their explanation of the universe. They seek to make one law explain as many phenomena as possible, and one more comprehensive law explain as many lesser laws as possible. In like manner they seek to make the laws acting at present in the sphere of our own observation explain whatever they can possibly explain in the past time and in the distant space.

What is this gulf-stream flowing over the modern mind? It is what Newton calls the Law of Philosophizing, which has been followed more or less consciously or instinctively in building up the whole structure of our modern science. Sir William Hamilton calls it the Law of Parsimony. It is a law or habit of thought which determines the mind to be as parsimonious as possible in the use of laws and causes. It assumes that the Divine Mind does nothing

needlessly ; that God never employs more methods or agencies to effect His purposes than are absolutely necessary ; and that He never changes His agencies or methods as long as they are sufficient to effect His purposes. Bacon seems to have been the first great mind that gave itself up to this great law, and set human thought strongly in this direction. Yet it may be that the "Novum Organum," after all, was but the crest of the wave that had already set in towards knowledge gleaned by induction from observed laws. The law of parsimony, which really lies at the root of the inductive method, had been stated in the middle ages by Occam, "*Entia non sunt multiplicanda præter necessitatem*"—Entities are not to be multiplied beyond necessity. Aristotle had long before laid down the same principles : "God and Nature never operate without effect," οὐδὲν μάτην, οὐδὲν ἔλλειπῶς ποιοῦσι—they never operate superfluously, μηδὲν περιέρχον—περιττῶς—ἀργῶς—but always through one, rather than through a plurality of means (καθ' ἓν μᾶλλον ἢ κατὰ πολλά). And well might this law be called the "Razor"—"Occam's Razor." It is in truth the magic blade whose keen edge has cut through a thousand established notions which seemed durable as adamant. It has mowed down before it old philosophies and superstitions, and to-day the cherished theologies of the past are falling at its touch. It is almost impossible to contemplate without trembling its wondrous power, and the extent to which it has revolutionized, and is destined still more to revolutionize, all human thought. But to Newton even more than to Bacon are we indebted for the application of this law of philosophizing to the construction of science. He shewed its value by presenting men with its practical fruits. His system of the universe was the first, and perhaps greatest, of the triumphal arches which were henceforth to glorify the march of the inductive and parsimonious method. Newton not only exhibited the possibilities of the method, but he stated the law which lay at its basis, and called it the Law of Philosophizing : "*Effectuum Naturalium Causæ, non plures sunt admittebdæ quam quæ et veræ sunt, et effectibus explicandis sufficiunt*"—which freely translated is, "We must admit no more causes for natural effects than those which are already known, and which are sufficient to explain the effects." This is the Newtonian form of the Law of Parsimony, and

we may almost consider it as a prophetic seizure, by a great mind, of the law that was to rule the thinkers of succeeding ages.

Let us now notice how the men who have built up our modern science have shewn in their thought the influence of the law which is here laid down. We see Newton himself, under its influence, searching for a greater unity in the world of astronomy than could be found in the cumbrous cycle, epicycle and eccentric of Copernicus, or the vortices of Descartes. He rejected unknown and imaginary laws and causes, and took the law of gravitation observed in operation in his daily experience—observed as it brought down the apple from the tree and the pebble dropped from the hand—and extended its sphere to explain the planetary and sidereal motions in the most distant space. It is not, however, our intention to write a new “History of the Inductive Sciences.” We shall point only to a few results of the method in most modern times. We see Bunsen and Kirchhoff, Miller and Huggins, still following the path first trod by Newton. They apply to the stars the spectrum analysis which has proved such a potent instrument of discovery in detecting new substances on the earth. It had been found that different substances placed in a colourless flame and vapourized imparted peculiar colours to the flame, the light from which, passed through a prism, produced spectra characterized by certain lines and hues. By the application of this test, several new bodies, as caesium, rubidium, thallium and indium, have been discovered in quarters where they were not before even suspected. It is found that the solar spectrum gives lines exactly corresponding to the lines in spectra from terrestrial substances, except that the solar lines are dark instead of light. Now it is found also that in the spectrum, from a bright sodium flame for example, dark bands are observed in the middle of the bright ones. From such and similar facts, it is argued, that those rays coming from the inner portion of the sodium flame, which have the same refrangibility as the rays emitted by the flame, are absorbed by the outer portion of the luminous vapour. This law of absorption is found to belong to all luminous vapours on earth. The law, then, is applied to the heavenly bodies; and it is argued that the dark lines on the solar spectrum are due to the presence of luminous vapour in the

outer portion of the sun, which absorbs the rays of the same refrangibility as its own given by the luminous substance in the inner portion. Hence Kirchhoff infers that the sun's atmosphere contains vapour of iron, calcium, magnesium, sodium, chromium, nickel, barium, copper and zinc. In a paper read by Dr. W. A. Miller and Mr. Huggins at the last meeting of the British Association, it was stated that the spectrum analysis had been applied by them to Jupiter and Mars, as well as to some of the fixed stars. But the most interesting discovery was gained by the application of the analysis to the nebulae. In some of these Mr. Huggins found that there is no solid matter at all. They are nothing but masses of intensely heated gas. The results from one of them revealed the astonishing fact, that it was composed of hydrogen and nitrogen, without any solid nucleus whatever. All these conclusions, let us observe, depend upon the principle, that, since the law of light observed in terrestrial substances near is sufficient to explain the phenomena presented by celestial substances far away, we are bound to apply that law and exhaust it before we invent another.

We may turn from these results of the law in celestial science to notice very similar results in all the sciences which have regard to earth and man. Max Müller applies the law to explain the growth and development of language, precisely in the way in which Darwin applies it to explain the development of organic life. Müller observes the manner in which languages still live in their natural state among the numerous tribes of Central Asia, Africa, America and Polynesia. There, language is in a state of constant fluctuation or regeneration, insomuch that a person leaving a tribe and returning to it again after a few years finds the language so changed that he can scarcely understand it. Moffat, the African missionary, shews how this variation may sometimes arise. "Fathers and mothers, and all who can bear a burden, often set out for a week at a time, and leave their children to the care of two or three infirm old people. The infant progeny, some of whom are beginning to lisp, while others can just master a whole sentence, and those still further advanced, romping and playing together, the children of nature, through the live-long day, become habituated to a language of their own. The more voluble condescend to

the less precocious, and thus from this infant Babel proceeds a dialect of a host of mongrel words and phrases joined together without rule, and in the course of one generation the entire character of the language is changed." Here, then, now operating is the law of variation which Müller supposes to have acted in ancient times, and to have led to the multiplication of dialects and languages, possibly, as he argues, from one primal dialect. He shews how the literary fixation of a language arrests its growth and life, and even begins its phonetic decay; and how one fortunate dialect—as, for example, the dialect of the ruling and literary classes—like a stronger species in the struggle for existence, gradually becomes the more general language of a country, and causes the slow extinction of other dialects, its less favoured competitors. In the Chinese or monosyllabic language, our professor sees an example of language in its most ancient form. There are no inflections, and the ideas expressed by inflections in more advanced languages are here expressed by separated words. In the Turanian languages, again, where the separate words still retain their meaning but are agglutinated together to form compound words, he sees an example of the second stage of language in which the inflections begin. In the Sanscrit he finds the third stage; the agglutinated roots forming the terminations of the nouns and verbs have here suffered phonetic decay, so that it is often difficult to determine what they originally were.

One of the most interesting of Max Müller's speculations is that in which he shews the constant tendency of poetic thought expressed in language to crystallize, so that a fleeting metaphor becomes changed into a hard and fixed reality. Any one who has attentively noticed the mental habits of children and country people, will have seen abundant examples of the operation of this law in the present. And this, according to Müller, is the great source of ancient mythology. Thus he accounts for the origin of the beautiful myth of Selene and Endymion: "Endymion is one of the many names of the sun, with special reference to the setting or dying sun. It is derived from *εν-δύω*, which originally meant to set or dive into. Endymion sleeping in the Latmian cave is the sun sleeping in the cave of Leto, the night. In the ancient, poetical and proverbial language of Elis,

people said, 'Selene loves and watches Endymion,' instead of, 'It is getting late;' 'Selene embraces Endymion,' instead of, 'The sun is setting and the moon is rising;' 'Selene kisses Endymion into sleep,' instead of, 'It is night.' These expressions remained long after their meaning had ceased to be understood, and as the human mind is generally as anxious for a reason as ready to invent one, a story arose by common consent and without any personal effort."

But we turn now to notice the effect of this great tendency of modern thought in the world of theology. Here, it must be confessed, it has shewn itself less than in other departments of knowledge. The truth is, that until lately it has scarcely dared to enter here. Science has almost from the first been separated from theology. Scientific men have felt that if they would interpret nature truly, they must follow other methods of thought than those in vogue among theologians: whilst the latter have been on the whole so willingly ignorant of science that the scientific method has but slightly affected them. They have been carrying on the habits of thought of the middle and other unscientific ages in the midst of a world modified by the results of modern science. Still, here and there a mind, affected in some way or other by the spirit of this scientific method, has risen in recent times to shake by its questions the old theologies to their centres. A man like Theodore Parker is touched by this spirit when he sends far and wide the thought that the religious phenomena of the past must be explained, as far as they can be explained, by laws in action in the human soul at present; and that it is the same voice of a living God that we feel in our souls to-day, that all the revealers of ancient times have heard and sought to interpret by their thought, their speech and their life. It is the same scientific spirit that Strauss and Baur and Renan have manifested in endeavouring to explain the wonderful stories in the sacred records by the laws which originate similar wonderful stories in modern times.

Let the reader observe that we are not sympathizing with these iconoclasts in their conclusions. We are only endeavouring to shew the source and nature of their method. We shall be the better able to understand such speculations as those of the writers now in question, if we look at them, not as the morbid offspring of minds insane and perverse,

who take a delight in outraging and destroying all that others hold dear, but as the tentative application to theological notions and theories of the same test, the same law of parsimony, by which all the old scientific notions have been tested, to be most of them found wanting and doomed to pass away. Let us try to understand the true thought which lies at the bottom of this theological scepticism also. It is this: "There is now in action a law sufficient to account for the birth of all the marvellous stories of antiquity without having recourse to unknown laws, such as would be involved in actual miracles. We find this law in action in all localities where ignorance and superstition reign, originating stories of the marvellous and supernatural. Such a law rests in the credulity and inventiveness of the human mind. Now since we find the law sufficient to account for a thousand stories of the supernatural, of witches, ghosts, spirit-rappings, warnings, clairvoyances, Mormon inspiration and Roman Catholic miracle, may it not also be sufficient to account for the marvellous stories in the Scriptures?" This, we believe, is the real doubt with regard to miracle, not only in the minds of Strauss, Baur and Renan, but also in the minds of thousands besides; and the only way to meet the doubt is to shew, as was shewn in our last number, that the law by which modern stories of the marvellous arise is not sufficient to account for the origin of the stories of miracle recorded in the Gospels. Still we must frankly express our conviction, that though minds of a theological habit, who have kept away from the influence of the scientific method, will be able to assure themselves of the undoubted truth of the old histories, to minds of that scientific habit, on the other hand, the doubting question we have expressed will again and again present itself; and therefore it is most needful that for such, religious faith should be removed from all merely miraculous basis, and placed on that spiritual foundation where the intrusive question, if it come, can no longer threaten or disturb it.

We need scarcely point out to the reader that a considerable amount of the destructive criticism exercised by Colenso and others upon the ancient records, is still only an application to the past of the laws that prevail in the present. We turn, then, to notice how the same tendency manifests itself in the general world of physics.

Carpenter, Matteucci, Grove and Tyndall, with many others, have been dissatisfied with the old notions of the multiplicity of physical forces ; and finding the theory of one primal force acting in different ways and with various motions sufficient to account for the phenomena of light and heat, actinism and electricity, magnetism and nerve force, have felt bound to adopt the theory, and to conclude that all these forces are correlated, and convertible the one into another. But the reasoning cannot stop here. It is precisely by similar arguments that Boscovich and Priestley, and more recently Faraday, reduce matter itself to force. They shew that all the essential phenomena of matter can be explained by the supposition of the forces, repulsion and attraction, radiating from a central point, and therefore feel bound to believe that what we call matter is only the form which the primal force puts on. Many lovers of physical science seem willing to stop here ; and while they scout with indignation and contempt the presumption of the ignorant, which tells *them* at every step that they can go no further—that they cannot know the nature, constitution, size and motion of bodies so far removed in the infinite spaces—that they cannot know what took place in this earth countless ages before we were born—that they cannot know what light is, what matter is—while the savans calmly go on applying the law of parsimony, like an enchanted telescope, to read the distant and the hidden, they in *their turn* pretend ignorance when they come to the point where force itself begins. Yet with this ignorance as a basis, all the grand discoveries of our science do but make a vast and terrible system of materialism, a world of awful forces—developments running back into eternity, systems of worlds stretching into infinity ; but without a God, without a purpose, without a spiritual meaning, without a message from a Father to His children. But, in truth, we cannot and will not stop where the materialists would have us stop. We laugh at *their* presumption in telling us we can know no further. We insist upon using their own instrument of discovery to the utmost. They tell us that we know nothing of any real originating cause. We answer, we do know one real originating cause, our own will ; and we know no other. A will, similar to our own, but infinite, is a cause *sufficient* to account for the existence of the forces in the universe.

A will, directed by intelligence and love, is *sufficient* to account for the order, the beauty, the happiness, the spiritual life, the development towards perfection, which these forces so evidently subserve. We are bound, then, by truthful and consistent adherence to the great scientific law, to rest in the admission of such a Will as the great originating and all-supporting Cause, and not to imagine some other cause, some blind Life of Nature, of which we know nothing.

There is no possibility of resisting this conclusion without giving up the whole spirit of science. We are not permitted, when we have once enlisted into the ranks of true scientific inquirers, to stop just where we please, to make our personal tastes a measure of truth, and to refuse to march on because we have no liking for the region which lies before us. And there is deep consolation for religious souls in the perception of this ultimate tendency of the great scientific principle. These terrible men, who have so often made our faith turn pale and tremble to the centre with their daring theories, who have torn away from us so much that once was dear and sacred,—they are, after all, marching on to a faith irresistible as their science. We have only to ask them to “move on,” to be perfectly faithful to their principle, and that principle, which has been so often the very instrument of scepticism, will become the key to open the kingdom of heaven. We do not pretend that this scientific method is the path by which every mind can best find its way to God. Multitudes of pious and humble souls will find themselves brought to Him by their own devout instincts quickened by sympathy with Christ. But, alas! it is perhaps the misfortune of the scientific mind that it cannot trust its instincts unless its science bids it. The value of the argument we have offered is, that it still sets the mind free that has determined to be faithful to the law of science. It shews such a mind that the severest application of that law only confirms the language of its own spiritual instincts.

Let the reader, then, take this ultimate oracle which science is compelled to utter, and he need not fear that in any of her discoveries, now or hereafter, she can tell us there is no God. The theories of Darwin and Huxley, even if they are true, are only discoveries as to the modes of God's operations; they are only discoveries that He acts by development, instead of by creation according to the old concep-

tion. The Great Cause Himself they do not touch; they neither truly put Him farther from nor bring Him nearer to us, for science beforehand shews us that He is the beginning and the end. He is the Infinite Being from whose living will issued the primal forces that clothed themselves with the first forms in the vast scale of development. His living will has sustained these forces ever since, as the fountain sustains the jets that clothe themselves with rainbow hues, as the sun sustains the light that clothes each day the universe with beauty. The development—or creation—that we see is but the unfolding of His thoughts, the climbing through infinite gradations to His great purpose.

Resting, then, upon these thoughts, we proceed to examine the theories of the geologists and physiologists as to the antiquity of man and the origin of the organic world in general. Here we find the same law which has met us in other quarters.

The whole of Lyell's writings are pervaded by the scientific spirit, the spirit of parsimony. In the grinding down to-day of rocks by waves along the coast, disintegration by rains washing the whole surface of the land, and the spreading out of the sand thus obtained over the bottom of the sea, he sees an explanation of the way in which beds of rock have been formed, and portions of the same or others ground down through countless ages. In the slow oscillation of large tracts of land, like Scandinavia and Greenland, the first of which is slowly rising, and the second as slowly sinking, he sees in operation the law by which continents and islands have been elevated and submerged through periods too vast for human thought.

Some think that Lyell has carried this principle of explanation too far, and that in past times there may have been other causes than we now observe, or that the causes now observed may have acted with greater intensity than at present. He would probably reply, "We are not at liberty to imagine what may have been until we have exhausted the possibilities of the laws now in operation. If the Newtonian law of philosophizing—that is, the law of parsimony—is to be acknowledged as supreme, then all you are entitled to ask is, 'Have you kept within the law?' In other words, are the causes which we discover in the present sufficient to account for the phenomena of the past? If

they are, to invent other causes, or causes acting with greater intensity than the phenomena need for explanation, is to throw aside, when its revelations do not suit our prejudices, the perspective glass by the use of which the whole of our world of modern science has been discovered, and to substitute the wilful dreams of our own fancy for the reverent conclusions of science."

The same method of reasoning has been applied to read the history of man. *A priori*, it was long ago argued that the growth of man, seen in the present on the line stretching from barbarism up to a higher civilization, has gone on through the past, and that man has everywhere begun at the point of savage life, and developed upwards to what he is at present. But such a process, it was argued, required a longer time than the biblical chronology afforded. This theory has now been established by the discovery of the remains of man, which shew that he existed on this globe in a savage state more than twenty thousand years before the biblical era had even begun. Still it must be borne in mind that the very interpretation of these remains is effected only by application to the past of the laws observed in the present. A number of splinters of flint, all of a similar type, are found buried in gravel or the floors of caverns, along with the bones of antique quadrupeds—mammoth, and two other species of elephants, lions, bears, hyenas—all extinct long ages since. These flint shapes resemble the flint knives, arrows and hatchets used by the Australian and other savage tribes to-day; and it is inferred, therefore, that they were used by ancient men in a stage of civilization very similar to that of these modern savages. These flint implements have been found in gravel-pits near Amiens and Abbeville, in the valley of the Somme, in a cave near Wookey Hole in the Mendip Hills, in the caves of Gower in Glamorganshire, in the Brixham cave near Torquay, in ancient river gravel in the valley of the Ouse near Bedford, at Hoxne and Icklingham in Suffolk, in the valley of the Thames, in the valley of the Darent, Kent, on the shore at Swalecliff, near Whitstable, in the valleys of the Seine and Oise, and other localities which are constantly being added to the list. These flints have in the places now named been found associated with the bones of one or more of the following species of quadrupeds—the mammoth and other extinct elephants, the

rhinoceros, tichorinus, the cave bear, the cave lion, the cave hyena, the wild bull, the Irish stag, the wolf and the fox, and several species of deer. But not only the tools, in some instances also the bones, of these primitive men have been found. In caverns near Liege, Dr. Schmerling has discovered such bones in association with the bones of the extinct cave bear, hyena, rhinoceros and elephant. In one of these—the Engis cavern—he discovered the remains of three individuals, and found the skull of one young person embedded by the side of a mammoth-tooth. Another skull, that of an adult individual, was found embedded in breccia, with the tooth of a rhinoceros and other bones. In another of these Liege caverns—that of Engihoul—Schmerling found the bones of men at different depths in the cave-mud, and the bones of the extinct quadrupeds above and below them.

In forty of these Liege caves flint knives have been found, though the bones are so rare. Human remains of a remote geological age have been found also in the valley of Neanderthal, near Düsseldorf. A human skull and portion of a skeleton were discovered embedded in the original cave-loam, and probably belonging to the same age as that of Engis; but as no other bones are found in association with them, their age could not be exactly fixed. There has been much discussion respecting this Neanderthal skull. Professor Huxley asserts that it is the most ape-like of any that he has ever beheld.

Schaafhausen says of the Neanderthal skeleton that the thickness of the bones was very extraordinary, and that the elevations and depressions for the attachment of muscles were developed in an unusual degree. The ribs, too, seemed to indicate great power in the thoracic muscles. The skull of the native Australian seems to occupy a station midway between that of Neanderthal and that of Engis. And Huxley says, "The marked resemblance between the ancient skulls and their modern Australian analogues have a profound interest, when it is recollected that the stone axe is as much the weapon and the instrument of the modern as the ancient savage."

One of the most interesting deposits of these aboriginal human remains is that found near Aurignac in Haute Garonne. Here, in 1852, a peasant pursuing a rabbit to its hole and inserting his arm, drew out a human bone.

Digging into the hole, he came upon an upright slab, which proved the door into a cavern filled with bones. It seems that seventeen skeletons were removed thence to the neighbouring churchyard. Lartet, who afterwards explored the spot, found on the outside, near the entrance to the cave, a kind of floor, about seven inches thick, made of ashes and charcoal, and mixed with bones and flint implements. Among the cinders were found fragments of sandstone reddened by heat, and which had evidently formed a hearth. Mingled with the ashes and earth were the bones of the cave bear, brown bear, cave hyena, mammoth, Siberian rhinoceros, horse, ass, gigantic Irish deer, bison, &c. &c. These bones were all broken, as if the flesh had been the food of human beings who had split the bone in order to obtain the marrow. The spongy parts of the bones had been apparently gnawed and eaten off after they had been broken. Lartet infers that this was the work of hyenas, whose bones and coprolites were plentifully mixed with the cinders and overlying soil. Many of the bones of the herbivora had been burnt, as if the flesh upon them had been cooked. Such, then, were the facts. Now for their interpretation.

Lartet takes the funeral rites among tribes of North American Indians, described by travellers in modern times, to explain these remains of the past. The cave, then, was a sepulchral vault where a rude tribe had buried the remains of their friends. The bones of the cave bear found in the cavern were an indication of the kind of food placed with the departed to support them on their long journey. A new flint knife and a carved bear's tooth, found also in the interior, had been parting gifts buried with the dead. The cinder-mixed floor outside, with the reddened stones and bones split and burnt, were the marks of the funeral feast held by the mourners at the cavern's mouth; and after the human feasters were gone, prowling hyenas came and gnawed the bones, the remnants of the funeral banquet.

And now let us glance at the method which the geologists employ to construct the mighty calendar stretching back into the past, by which the distance of time between ourselves and the period when these primeval men inhabited Europe is approximately fixed.

First, then, it is argued that the fact that the same animals now extinct, the mammoth, the rhinoceros, the lion, the

bear, the hyena, &c., were found at this period both in this island and on the continent of Europe, shews that the island was then united to the continent, and that both animals and men roamed through wilds and forests extending from Ireland at least to the Uralian mountains.

Secondly, it is argued, by the marks of glaciers found on the sides and round the bases of most of our lofty mountains—Snowdon, for example—and the evident remains of moraines left in the mountain valleys by the melting of the ice, that at this period all the high mountains of this island must have been clothed by glaciers. Now these, with the moraines which they have left, could not have belonged to an earlier period, before the land was deeply submerged beneath the ocean, for then the moraines would have been swept away or covered by ocean drift.

Thirdly, the connection of this land with the continent implies an elevation of at least 600 feet above its present level, while the position of stratified drift on the side of the hills shews that just before this period the land had been depressed at least 800 feet below its present level, so that on the last elevation the land must have risen 1400 feet. Professor Ramsay says the land was depressed 900 feet lower than this, so that it must have risen 2300 feet. Now measuring the rate of motion by that observed in the present rising of the Scandinavian peninsula, $2\frac{1}{2}$ feet in a century, this will give five hundred and sixty centuries at the lower, and nine hundred and twenty centuries at the higher computation. Let us suppose the land without pause to have begun to sink again, the moment it had attained its highest elevation, and to go on sinking 600 feet till it had attained its present level. Let us then suppose that the first records of man date only from the period when the great continent with its glaciers began to sink. This would carry us back 24,000 years. And when we think of the mighty changes that have taken place in the physical conditions of this portion of the earth, whether through complete alteration in the direction of the gulf-stream, or through elevation above the ocean of the air-heating desert of Sahara, melting the ancient glaciers—when we think of the extinction of such numerous species of organized being, the mammoth, the rhinoceros, &c., that once inhabited these regions, we can scarcely avoid feeling these twenty-four centuries a moderate computation.

The remains of man found in the ancient Danish kitchen middens and the Swiss lake dwellings appear to be of more recent date than those before mentioned. They shew some slight advance in civilization ; but as they belong to a period when the mammoth and rhinoceros had apparently passed away, their principal value seems to be to shew the long continuance of the savage period.

In Denmark, in hollows found in the northern drift, there lie strata of peat one above the other, from 10 to 30 feet in depth. Buried around the borders of the lowest strata, abundant remains of the Scotch pine are found, shewing that the face of the country was once covered principally with forests of this tree. Above them are buried, instead of the pine, frequent remains of the common oak, shewing that the pine had passed away and the oak had taken its place. Higher still occur the buried trunks of another kind of oak, with alder, birch and hazel. The forests which must have been composed of these latter trees have in their turn passed away, and the beech is now, and has been through the historical period, the prevalent forest growth. It has been stated that a stone implement was found under a buried Scotch fir at a great depth in the peat. By collecting and studying a vast quantity of such implements and other articles of human workmanship preserved in peat and in sand-dunes on the coast, as also in the shell-mounds of the aborigines, the Danish and Swedish antiquaries and naturalists, Nilsson, Steenstrup, Forchhammer, Thomson, Worsåae and others, have succeeded in establishing a chronological succession of periods, which they have called the ages of stone, of bronze, and of iron, named from the materials which have each in their turn served for the fabrication of implements. The age of stone in Denmark coincided with the Scotch fir and part of the oak. The rest of the oak period coincided with the age of bronze. Swords and shields of that metal now in the Museum of Copenhagen have been taken out of peat in which oaks abound. The age of iron corresponds more nearly with that of the beech-tree, which characterizes the historical period. The remains of the kitchen middens belong to the age of stone, though to an advanced period of it, when the ancient men had learnt to grind their flints (as do the Australians) as well as to chip them. The period of the Swiss lake dwellings appears to have reached from

the stone into the bronze period, and in some few instances to have come down even to the age of iron.

We have then traced the history of man far back into the past. We have seen signs of a gradual, though it may seem, compared to our civilization, a slight improvement from chipped to ground flints, from implements of stone to those of metal ; but still this period of man's existence seems to stretch back only a hair's breadth into that awful vista of ages which geology opens dimly to our view.

After all, when we come back to this glacial period when man co-existed with the extinct quadrupeds, we are but in the outer edge of the post-tertiary and glacial epoch ; we are still in the times which geologists call the recent. Behind us stretch millenniums beyond millenniums, during which—still interpreting by the laws of the present—we see the water slowly grinding down the rocks and depositing them as sand over the ocean bed, to be converted into new rock. The remains of the races of animals and plants existing during this long slow process of disintegration and re-creation, are entombed in the sand, to be found hereafter fossilized in the rock. We could now in some places descend through a thickness of more than ten miles of strata, which have been thus formed from the destruction of pre-existing lands. And, calculating from the rate of demolition and reproduction observed in modern times, we may safely say that the period necessary for all this cannot be less than nearly a hundred millions of years.

But when we come to the beginning of the period which the great stone book dimly reveals to us, what is still beyond? The records on the rocks which lie deepest, even the marks of stratification, seem obliterated by time and often apparently by heat, and it may be that strata have existed and become fused again which once bore in them the records of another period vast even as that over which we have endeavoured to glance. The mind breaks down under the effort to conceive the immensity of ages. Sir C. Lyell says :

“ It is related of a great Irish orator of our day, that when he was about to contribute somewhat parsimoniously towards a public charity, he was persuaded by a friend to make a more liberal donation. In doing so, he apologised for his first apparent want of generosity by saying that his early life had been a constant

struggle with scanty means, and that 'they who are born to affluence cannot easily imagine how long a time it takes to get the chill of poverty out of one's bones.' In like manner we of the living generation, when called upon to make grants of thousands of centuries in order to explain the events of what is called the modern period, shrink naturally at first from making what seems so lavish an expenditure of past time. Throughout our early education we have been accustomed to such strict economy in all that relates to the chronology of the earth and its inhabitants in the remote ages, so fettered have we been by old traditional beliefs, that even when our reason is convinced, and we are persuaded that we ought to make more liberal grants of time to the geologist, we feel how hard it is to get the chill of poverty out of our bones."

And still, when we come to the beginning of this most ancient period, what is beyond? The indications of great heat and fusion still in the interior of the earth naturally suggest the idea that this globe has once been molten; and chemical analogies would then lead us back to the time when the liquid mass had not yet been condensed, but was portion of a vast gaseous nebula from which the sun and its planets were not then disentangled, and which, as it rotated on its axis, threw off successive rings that broke up and arranged themselves into planetary globes. The nebular hypothesis has received new confirmation from the spectrum analysis before referred to. The gaseous luminous nebulae discovered by Miller and Huggins are exactly in the condition in which we should expect the primeval nebula to be.

And yet we cannot avoid asking even here, What was before this nebular period? Is this the beginning, or is it only the end of one and beginning of another of an infinite series of phases through which creation is passing? Was the nebula only the combustion of worlds that had passed through a previous history and come to an end? Are the sublime images of Scripture as to the final conflagration of the world, prophecies of the actual destiny of nature? If the nebula was the vaporization of worlds previously solid, and if the worlds now solid are hereafter to be vaporized, there must be somewhere in the universe—according to the doctrine of the conservation of force—some reservoir of force, unknown to us, capable of effecting the vast combustion. But what awful ideas pour upon us when we not only

think that in the state of things which we see to-day we behold but one of an almost infinite series of phases through which our present creation is passing, but also that this present creation itself, with all its millions of centuries, may be only one phase in an infinite series of creations stretching through eternity! All the present form of nature—earth below and stars above—constitute then but one vesture of the infinite and living force. As a vesture shall He, the source of that force, change the form, and “it shall be changed; but He is the same, and his years shall not fail.”

We go back once more to notice the application of the great law which we have traced, to the explanation of the origin of species in the world of organic life.

Darwin and Huxley, Quatrefages and Kölliker, then, are dissatisfied with the old theories of creation, in which causes or laws were imagined that are not seen in action now. The old doctrine supposed miraculous interventions in the regular course of nature. It assumed that there were, at epoch after epoch, fresh acts of creative energy by which new species were introduced upon the earth. But Darwin attempts to explain the variety of species, both of plants and of animals, and the introduction of all new species in the past, by the operation of laws of variation and selection which are observed in the present. The grazier and the gardener find constant but small variations in the individuals composing their stock. They select for breeding the animals or plants possessing any variation which makes them more valuable than the rest, and then from their offspring select again the individuals possessing the variation in greatest perfection, and thus by this accumulative selection in the course of a few generations a new variety—cattle with shorter horns, sheep with finer wool, race-horses with more and more resemblance to the greyhound, fruit trees with richer and larger fruit—is produced. There has been similar variation, says Darwin, through all the past; and nature, by the constant struggle for existence of every creature, makes selection of the individuals possessing any variation that would give them the slightest advantage above their competitors in the race for life. It selects from the offspring of the favoured creatures those which have the useful variation in greatest perfection, and thus are produced new varieties which gradually develop into species.

Darwin is inclined to push his theory so far as to account for the origin of all organized beings. He says: "Therefore I should infer from analogy that probably all the organic beings which have ever lived on this earth have descended from some one primordial form, into which life was first breathed by the Creator."*

But if Darwin's theory is true to this extent, there is no satisfactory reason for our stopping here. The same movement of the mind, seeking to explain creation in the past by the laws of development which we see in the present, would lead us to follow back the line of development until we come to those ultimate atoms or molecules of which all organized as well as inorganized forms are constituted. Accordingly, some of the savans follow the process to this extreme, and suppose that there is a development from inorganic to organic forms—that, in truth, each atom of matter is a germ or egg endowed with a low measure of vitality, which under certain conditions becomes quickened and leads to spontaneous generation. Thus, according to them, the creation of organic life is ever beginning again. It is a fact of the present. Inorganic atoms are constantly being united and quickened into low forms of organic life. Professor Kölliker says: "My fundamental law is, that the production of the entire organized world is founded upon a great plan of evolution, which constantly impels the simpler forms towards more and more complicated developments." He shews how one form does often produce germs which develop into different forms. "A bipinnaria, a brachiolaria, or a pluteus, is capable of producing so different a creature as the echinoderm. A hydriform polype produces the higher medusa, and the worm-like trematode-nurse forms the totally different cercaria in its interior; and," so he argues, "it cannot appear to be impossible that the ovum or the ciliated embryo of a sponge under particular conditions might become a hydriform polype, or the embryonic medusa become an echinoderm."

At the last meeting of the British Association at Bath, Dr. Dickson read a paper in which he took the ground that every individual molecule was endowed with life, and consisted of double actions of positive and negative; and Dr.

* *Origin of Species*, p. 484.

Bennett, after alluding to the experiments of French physiologists with regard to spontaneous generation, stated his conviction that infusoria could be created where no living cell existed before.

We do not pretend to endorse or reject these theories of development. We wait for further light. Many of the most eminent men of science have, it is true, embraced the theory of transmutation; but we frankly confess that our knowledge of all the laws and conditions of variation at present, and of the records of the past entombed in the rocks, is far too restricted to enable us to form satisfactory conclusions on so vast and mysterious a subject. For ourselves, we are prepared to accept whatever explanation of God's method in creation science can verify, knowing that it is only His method with which she is here concerned; and that, whatever may be the method used, He is equally present. And if we should at last be brought to acknowledge that a lower animal form has been gradually developed to humanity—that a reptilian form has been developed into the bird, the fish into the reptile, the medusa into the echinoderm, and the inorganic atoms themselves into the infusoria or sponge—this will not in the slightest degree disturb our religious faith. We shall only say, "God has chosen to adopt this method of creation, instead of the method which we once believed; but He has been present at every step. It is His outflowing, all-pervading Life that has quickened the lower forms and developed them into higher." We shall think of Him as quickening into higher organization the embryo of some anthropoid animal, and breathing into it the breath of human life, just as we used to believe He quickened into such an organization the dust of the inorganic earth. And we shall feel it no more degrading to have been created from material already vitalized in an animal form, than to have been created from dead inorganic matter, the very "dust of the earth."

As to the questions which suggest themselves—"When and how was the soul breathed into the human being? Had the lower animal a potential soul which could be quickened into the soul of man?"—we can give no answer, though we would point out to our readers that the same questions press upon us now from the simple facts of our physical birth and growth. The human embryo now passes

through stages very similar to the grades of the mollusk, the fish, the reptile, the bird, the quadruped. At which of these stages is the soul introduced? Is it potentially in the lowest and developed with the form? Here we must be content to remain for ever in ignorance. The genesis of material bodies may be a subject within the sphere of observation, but the genesis of spirits lies certainly beyond it.

We have thus endeavoured to bring into clear observation the law of thought, the force which is the great moving power in the modern intellectual world, the instrument of our knowledge and the source of our scepticism. We have endeavoured to shew the point in each department towards which the great movement tends. The prospect of being drifted away to such far and foreign goals will appear very terrible to many. They will seem to themselves carried away from all that was dear and familiar, into regions cold and stern and awful, where they feel as exiles from the home of youth.

But it is useless to complain, weak and childish to linger whining and shivering on the shore, trying by our weak cords to tie down and hold back the structures that are already loosened and ready to be swept away. Far wiser and manlier is it to cast ourselves upon the tide, put ourselves at the head of the fleet of explorers, and be determined to see where the great current will really bear us. The greatest danger now is from the materialists, who would have us go on so far as to leave behind all that we have loved and revered, but who, like the sailors of Columbus, cry they are come to the end of the world, when only the sea-weeds of a sluggish spiritual nature are lying across their path. We must insist upon keeping faith with the true spirit of science, and of going on to where it brings us to the great spiritual cause of all laws and all phenomena. Then the stream will have brought us to the true goal, where

“Our souls have sight of that immortal sea
Which brought us hither,
And see the children sport upon the shore,
And hear the mighty ocean rolling evermore ;”

and we shall find that we have been sailing near the ocean always. We shall look back and know that our Christian belief has not been a mistake. We shall see how those who

from the olden time have spoken to us of God, stood upon the mountain-heights where they saw His awfulness and heard the murmur of His deep. The past as well as the present will still echo with His voice, and the Christ and those who have drawn us to the Father will never be separated from our love.

III.—THE BOOK OF DANIEL.

Daniel the Prophet. Nine Lectures delivered in the Divinity School of the University of Oxford, with copious Notes.
By the Rev. E. B. Pusey, D.D. 8vo. Oxford and London: Parker. 1864.

A VOLUME of above 600 closely-printed pages upon one of the most curious and enigmatical books of the Bible, proceeding from the profound learning and mature wisdom of the Oxford Professor of Hebrew, awakens anticipations of no common kind. The "Book of Daniel the Prophet," perhaps more than any other of the Old Testament, demands refined scholarship in the Hebrew and Chaldee tongues, only to be gained by the experience of years. And its historical demands can be satisfied only by a scholar who has thoroughly *read himself into* the spirit of the times which it describes and those to which its composition might be referred, so as to appreciate their intellectual and religious colouring as well as understand their hard facts. On both these grounds Dr. Pusey's name raised high expectations. He has been Regius Professor of Hebrew for thirty-six years; and in 1835 he gave to the world the proofs of his Semitic scholarship by publishing the Catalogue of the Arabic Manuscripts in the Bodleian Library. Though the acknowledged leader of a great party in the Church, he has lived the life of a student, if not of a recluse. To whom, then, could we look with more hope for an interpretation of Daniel?

But the very first sentence of his book blasts all these hopes:

"The following lectures were planned as my contribution against that tide of Scepticism which the publication of the