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SCRIPTURE AND SCIENCE.

By THOMAS LUMISDEN STRANGE.



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NUMEROUS have been the attempts to make it appear that the statements respecting the world and its products presented in what is assumed to be the word of God, and the facts coming to us from scientific observation, are not at variance. At the outset of this contest the biblical defenders made a more or less plausible stand against the advancing knowledge bearing upon the subject, but as information has increased they have been driven to new shifts to keep their ground, or have had to retreat where the adverse testimonies have proved too strong to be resisted. For example, no one now maintains that the earth is the centre of its associated system and is motionless, not even revolving on its axis, while in respect of its antiquity most biblicists are satisfied that the scripture has to be read in some manner to allow of a period of immeasurable duration being accorded thereto. On the antiquity of man the battle is still maintained, though here also some are disposed to make concessions by giving up the integrity of the scripture genealogies.*

I have selected, to promote the examination of these questions, the work of the late Archdeacon Pratt, entitled "Scripture and Science not at Variance," as one that has occupied its place through a good many editions for nearly twenty years, and as coming from one of recognised scientific attainments, who was at the same time a dignitary of the church. The writer thinks

* *The Legends of the Old Testament* (Trübner & Co.), pp. 186-189.

the position he has taken up so satisfactory, that, whatever the facts yet discoverable in the realms of science, believers in the Bible may rest assured that none can appear to contradict the statements of the scripture.

The Archdeacon's examination is confined to what appears in the first eleven chapters of Genesis. His view of the narrative of the creation is that the first and second verses in Genesis relate to a period antecedent to the six days, the acts of which are described from the third verse onwards. In this early period he conceives all the strata of the earth were laid down, with their fossilized deposits, till we reach the Quaternary period in which we stand, and he holds that then occurred the present creation which was accomplished in six natural days. Thus the vast antiquity of the earth and of its stocks of ancient vegetation and animals, as demonstrated by the geologists, is admitted, while the existence of the human race is limited to the six thousand years traceable in Genesis.

The interruption claimed between the first and second and the third verses of Genesis is not expressed in the text. To the natural eye a continuous narrative is presented. The first and second verses, as a prelude, declare that "In the beginning God created the heaven and the earth," and that the earth at this time was "without form and void," and then we are told in what manner he carried out his work through the six days occupied in completing it. All that can be designated creation was, we are to understand, embraced in these six days. There was no creation before their occurrence, and none subsequent thereto. This is what in the natural acceptance of the text we are taught in Genesis, and this is the construction that all men put upon the narrative till facts appeared to disturb its statements. That in the beginning, before the occurrence of the six days, there was a vast development of creative power upon the earth, is a piece of information not communicated in the text, but arises solely, as the biblicists must

admit, from the facts ascertained by the scientists, of which, otherwise, the Bible readers could have possessed no knowledge. On the contrary, they would come away, and did come away, with the conclusion that the operations of God in connection with the earth began on the first day the text speaks of. Nor is it consistent with the statement that previously the earth was "without form and void," to allege that during this prior period all those orderly strata, stored with the remains of vegetal and animal forms, which we see prevailing to the end of the Tertiary deposits, were laid down upon the primeval crust. The Carboniferous and Cretaceous sections may be particularly instanced as occupying each its place in very distinct form, and as teeming, the one with the remains of terrestrial vegetal, and the other with those of marine animal life, in prolific abundance.

The Archdeacon concludes that "an interval of time of untold duration" intervened between the ancient and the modern creations, and supports himself with the statement of M. D'Orbigny, "that not a single species, either vegetable or animal, is common to the Tertiary and the human periods," admitting, however, that this is a view commonly disputed by other geologists, and especially so by Sir C. Lyell. The fact is, in nothing are competent observers more united than in the opinion that the products of the earth and sea have been raised up by continuous action, the changes effected being graduated by the interlacing of forms with one another, so that nowhere has there been a belt indicating absolute interruption of the creative processes prevailing at any one period over the whole surface of the earth, as the view now in question necessitates. The sections I have just instanced, namely the Carboniferous and Cretaceous deposits, give evidence of continuity, linking the old with the modern operations, and showing that there has been no such disjunction in the courses of creation as the writer contends for. The peat bogs now

on the surface of the earth appear to be coal in embryo, and assuredly large tracts of marine exuvia recently found at the bottom of the Atlantic must be chalk in embryo. The climatic changes from temperate to tropical or arctic degrees which the earth has undergone in remote ages, and is still undergoing, also demonstrate the continuousness of the creative acts. M. D'Orbigny, it is to be observed, speaks of there having been twenty-nine creations separated from one another by catastrophes which have swept away the species preceding them. This goes beyond the requirements of Genesis as interpreted by our author, and it may be assumed that the observations on which the statement depends were made over detached surfaces of the earth, and do not therefore embrace its entire superficies. The occurrence of such partial changes or disruptions to which our globe has been subjected by floods, alterations of levels, or marked alternations of climate, all geologists will acknowledge, but this by no means presents us with the chaos of Genesis, for which, it is universally allowed, the requisite marks are wanting.

It is difficult to conceive the state of things appearing in the biblical record, as put to us by the Archdeacon, when even the atmosphere, or ether, with which the globe is surrounded, had in some manner to be formed and adjusted when the new creation was undertaken. The author, in endeavouring to support the language of the scripture as to this atmosphere, fails to deal with all that belongs to the representations made. He allows that "the ancients conceived the heavens to be an enormous vault of transparent solid matter, whirling around the earth in diurnal revolution, and carrying with it the stars, supposed to be fixed in its substance," and he strives to make it appear that the scripture statements do not necessarily involve such an idea; but he does not touch upon the true meaning of the scripture phraseology, or the conditions associated with this atmosphere, all of which imply its solidity.

The Hebrew term is *rakia*, which the author describes as meaning merely an expanse, and therefore possibly an ethereal expanse, while its true signification is something expanded by being beaten out thin as might be a solid substance. It is used in Isaiah xlii. 5 of the earth which is said to have been thus "spread forth," and accordingly it is rendered in the Septuagint *stereoma*, and in the Vulgate *firmamentum*, in keeping with the idea of solidity attaching to the atmosphere in early times.

The uses attributed to this expanse in Genesis require for it the element of solidity, or it could not have divided the waters that were above it from the earth and the waters that were below, the writer here showing his ignorance of the mode in which rain is generated by the free passage of exhalations from the earth to the heavens. Consequent upon the existence of the solid intervening expanse, when any passage had to be effected from the heavens to the earth, it became necessary that openings should be made through the interposed medium. These are termed "doors" (Ps. lxxviii. 23; Rev. iv. 1), or "windows" (Gen. vii. 11, viii. 2; 2 Kings vii. 2, 19; Isa. xxiv. 18; Mal. iii. 10). The "windows of heaven had to be "opened" to let down the rain for the deluge, and to be "stopped," or closed, when the rain had to be shut off (Gen. vii. 11; viii. 2); "the doors of heaven" were "opened" when manna was "rained down" to feed the Israelites in the wilderness (Ps. lxxviii. 23); "a door was opened in heaven" to admit John to the celestial glories which were above (Rev. iv. 1): "the heavens" were in like manner "opened" when "visions of God" were imparted to Ezekiel (Ezek. i. 1), when the celestial dove descended on Jesus at his baptism (Matt. iii. 16; Mark i. 10; Luke iii. 21), when "the Son of Man standing on the right hand of God" was displayed to the sight of Stephen (Acts vii. 56), and when a vessel full of four-footed beasts was "let down"

in view of Peter (Acts x. 11); and John saw in anticipation "heaven opened" when Jesus, as the embodied "word of God," has to come down in judgment upon the earth, seated on a white horse (Rev. xix. 11). This intervening expanse is also described as something tangible that admits of being "stretched out" or "spread out" (Job ix. 8; Isa. xlii. 5; xliv. 24; xlv. 12; li. 13; Jer. x. 12; Zech. xii. 1), as might be a "curtain" or "tent" (Ps. civ. 2; Isa. xl. 22); and in the last day it is to be "folded up" as a "vesture," and "rolled together as a scroll," and so removed and "changed" (Ps. cii. 26; Isa. xxxiv. 4; Heb. i. 12; Rev. vi. 14).

The formation of this substantial medium interposed between heaven and earth was the work of the second day. The Archdeacon discriminates between the various Hebrew words employed to denote what was "made" or "created," according the highest significancy to the term *bara*. This word occurs over fifty times in the scripture, and signifies the creation of something that before had no existence. It is applied in the first verse of Genesis to what was done "in the beginning," which the writer contends was the primitive creation, and it is equally applied to objects of the last or modern creation, which he distinguishes as belonging to the "human period." For instance, it is employed to designate the creation of man, of all the animal tribes, and in fact of everything made during the six days (Gen. i. 27; ii. 3; v. 2; vi. 7), and it is specially used in regard to the expanse or firmament with which we are now occupied (Isa. xlii. 5). It is apparent thus, according to the writer of Genesis, as interpreted by the Archdeacon, that this expanse, or as we now know it to be, ethereal space, had no existence during the pre-human period, and we have to understand, how we may, in what manner the teeming products, vegetal and animal, of the prior period, whose fossilized remains give evidence that they

were constituted as the life forms now on earth, requiring air to support their vitalities, could have existed without the surrounding ether.

The conversion of the "days" of Genesis into ages, while meeting one difficulty, involves others which are fatal to this theory. The period, whatever it was, embraced divisions that represented the occurrence therein of "western light" and "early dawn," which the translators recognize as meaning "evening" and "morning." It consisted thus of what we know as night and day ushered in by the "western light" and the "early dawn." The third age gave forth seed-bearing herbs and fruit-bearing trees. How was this to be accomplished without the presence and influence of the sun which was not "made" till the introduction of the fourth age? How could plants exist with the long-sustained alternations of darkness and light in the ages thus constituted? During the half age of sunlight the earth and its vegetable contents would be burnt up by the continuous heat, and the terrestrial animals would perish from lack of food. During the supposed half age of darkness, how could the animals obtain the constant supplies they need every few hours for their sustenance; and are we to conceive the sparrow, through this long period, perched in repose upon one leg with its head under its wing? When the division of night and day is represented by ages, what meaning are we to attach to the ordinance that the heavenly bodies were to "rule over" the "day" and "night," "dividing the light from the darkness" as now effected? We have moreover presented to us the serious disturbance of geologic order in the existence of the terrestrial seed and fruit-bearing plants, with an age intervening, before marine products were created. The Archdeacon reasons against this class of interpreters, disputing the conclusions of Miller, M'Caul, Dawson, M'Causland, and Warrington, and supporting himself on his side with the names of Chalmers, Buck-

land, and Sedgwick. Thus the doctors differ, and the simple student of nature finds them resorting to forced interpretations and violent assumptions, not warranted by the text, to free the scripture statements from the pressure of the realities which, to the natural mind, ever defeat the asserted revelation.

However the days of Genesis are to be estimated, all agree that with the formation of man on the sixth day the acts of creation ended. The Creator "rested" from his labours, whatever he had designed to do having been accomplished. People appear to forget the parasitical growths which infest all organized objects, plants, and animals. "The human body," the last of the forms produced in the days in question, Mr Herbert Spencer notices is "the habitat of parasites, internal and external, animal and vegetal, numbering, if all were set down, some two or three dozen species, sundry of which are peculiar to man." These must have been introduced after the supposed rest set in. If there were no men, observes Professor Huxley, there would be no tape worms. The course of creation consequently did not end with the production of man. But in fact there could be no such rest as has been declared, the maintenance of all things depending on the ever active sustaining and directing power of him who made them. No atom in creation is ever at rest, every form is undergoing continual change, assimilating what is appropriate to it, and advancing or receding and waning under a constant process of development or decay, and as it decomposes fresh forms are built up out of its constituents. Can such operations be carried on without the agency of the constructor of all things? Has matter independent capacity to enter into combinations, the divine ruler refraining from all interference as not required to regulate the results? This position biblicists cannot possibly admit. If "in him we live and move, and have our being," there can be no such cessation of agency on his part to constitute the rest imputed to

him. It is one ignorant of the processes of nature going on around us who makes the assertion.

We are told that "by one man sin entered into the world and death by sin." Death is hence said to have been introduced into this creation through the transgression of Adam. The remedy appointed is a new creation, wrought out in Christ, in substitution for that thus tainted and under judgment. The first Adam in this manner becomes displaced by Jesus, who is exhibited as the head of the new order of things. "The whole creation," it is said, "groaneth and travaileth in pain together until now," waiting for the deliverance; upon which there is to be "no more curse," and "no more death." Thus death is brought in and removed according to the scripture account. It was the penalty for sin, and disappears when sin no more prevails. But in the ages prior to man myriads of animals passed away through subjection to death, and it is apparent that death is due to an universal law applicable to all terrestrial life, and has not been brought into the world at the particular time, and under the special circumstances, which the biblical doctrine asserts; and with the dispersion of the asserted cause of death the provided remedy for death is equally made void. The Arch-deacon allows the feature of the extinct animals to present "a formidable difficulty," and from it he endeavours to escape by the supposition that man, as originally constituted, was exceptionally organized, so as not to be liable to that end of his physical being which overtakes plants and animals, and now man himself, as by an apparent universal law. The writer confesses that "no doubt, while ignorant of the fact which the book of nature reveals, we should conclude from the Apostle's words that it was the sin of Adam that had brought death upon the irrational as well as the rational creation." This, he says, is an instance where "science comes to our aid to correct the impressions we gather from scripture," a result which the students of nature will of course fully appreciate.

Archdeacon Pratt examines various other matters in respect of which the scripture statements are ordinarily called in question on the basis of being at variance with facts in nature scientifically ascertained, such as the form and motion of the earth, its antiquity, the unity of the human race, the common origin of languages, Hindú and Chinese astronomical calculations, creation in specific centres, and the phenomenon of the deluge, reviewing various well-known works touching on these subjects, namely, Bunsen's "Egypt's place in Ancient History," Lyell's "Antiquity of Man," Darwin's "Origin of Species," Huxley on the "Physical Basis of Life," and "Man's Place in Nature," and Bishop Colenso on the "Pentateuch." Over this well trodden ground it is not necessary that I should conduct my readers. I will endeavour, preferably, to meet the Archdeacon's challenge that there is nothing possibly obtainable from natural sources, as observable scientifically, beyond what he has treated of, that can prove at variance with the scripture representations. I have met him in regard to the earth's antiquity, showing that if the subject-matter of the first and second verses of Genesis relates to that of the verses that follow, the ancient deposits, stocked with vegetal and animal remains, now known of, contradict the idea derivable from Genesis that the first day of creation occurred about 6000 years ago. I will now occupy myself, on grounds hitherto little discussed or understood, with the time that man may be shown to have been on the earth, to which the like limit of the 6000 years is commonly assigned, a position attaching to the Bible statements from which there seems to be no fair means of escape.

It is a well ascertained fact that there have been very marked alterations of temperature upon the earth, the same region having been visited, for lengthened periods, with a climate that was at one time tropical, at

another temperate, and at another polar. Europe has at present a temperate climate, but its coal fields, which occur in all directions, demonstrate that it had formerly a degree of warmth equal to the production of tropical plant growth, and the glacial boulders scattered over its surface prove that it has also been under the domination of ice. The fossilized remains of its animals afford the like indications. When the climate was temperate, the ox, deer, boar, horse, bear, fox, badger, weasel, otter, lynx, and beaver possessed the land; when tropical, the elephant, lion, tiger, hyena, rhinoceros, and hippopotamus; and when arctic, the alpine hare, reindeer, musk sheep, woolly mammoth, and woolly rhinoceros. Melville Island, one of the coldest places visited by arctic explorers, has coal deposits, and marks of glaciers have been observed in Europe to about 50°, and in America as far as 31° north latitude, and similar signs prove their prevalence within the tropics in India and Africa.

The indications of glaciers are of a well recognized order. From some ill understood cause, these ice formations are subject to a slow, constant movement upon the earth's surface, and in their progress they leave behind them indubitable signs of their passage.

The first is till, or a stiff clay, they grind up as they move along. This has been found in places to a thickness of a hundred feet and upwards, proving the density and mighty weight of the moving ice deposits.

Another evidence of the passage of glaciers is the scorings on the rocks over which they have passed. The till carries with it hard pieces of rock which are themselves thus scored, and they act as ice chisels, gravings the rocks below along which they are grated. These marks of scoring run necessarily all in the same direction, and demonstrate the agency by which they have been effected.

A third evidence is the occurrence of erratic boulders. When the lower surfaces of the land are covered with

a thick coating of ice, the mountain tops standing above the icy plain are subjected to extreme cold which splinters off from them pieces of rock, often of considerable size, and these fragments, falling on the ice below, travel with it and are deposited wherever the ice finally disappears. In Scotland, Professor Geikie* informs us, they are to be traced from the Highlands to the Pentland Hills, from fifty to eighty miles off, to the low-lying parts of Fife, to the Lammermuir Hills, and onwards to Strathallan, the Ochil Hills, and the vale of the Forth, and they are found also in the valleys of the Clyde and the Irvine. They are met with on the slopes of the Jura, borne thither from the adjacent Alps. In India I have seen them on the high plains of Bellary, eastward of the great range of mountains running from Bombay to Cape Comorin, and on the opposite side westward a few miles out at sea off the coast of Malabar, where they bear the name of the Sacrifice Rocks, the distances from the mountains being some hundred and fifty miles in one direction, and fifty in the other. A correspondent of mine, a scientific observer, has seen them strewed over the table-land of Mysore and the lower level of Chittoor where they lay "scattered over a grassy plain extending for many miles," this latter region being some 250 miles from the mountains; and he observed one on St Thomas's Mount, near Madras, which must have travelled thither more than 300 miles. Du Chaillu gives testimony to the existence of these boulders in equatorial Africa, which is the more interesting as coming from one who, while recording the phenomenon, was wholly unable to account for it. He says, "Not far from Mokenga there was a remarkable and very large boulder of granite perched by itself at the top of a hill. It must have been transported there by some external force, but what this was I cannot undertake to say. I thought it possible that it might have been a true boulder

* *The Great Ice Age.*

transported by a glacier, like those so abundant in northern latitudes. . . . Whilst I am on the subject of boulders and signs of glaciers, I may as well mention that, when crossing the hilly country from Obindji to Ashera-land, my attention was drawn to distinct traces of grooves on the surface of several of the blocks which there lie strewed about on the tops and declivities of the hills. I am aware how preposterous it seems to suppose that the same movements of ice which have modified the surface of the land in northern countries can have taken place here under the equator, but I think it only proper to relate what I saw with my own eyes."* The boulders here in question must have travelled hundreds of miles from the central mountain region. These ice-borne masses are sometimes of vast dimensions. The great rock, estimated to weigh 1500 tons, which forms the pedestal of the statue of Peter the Great, is one of them. The Needle Mountain in Dauphiny, measuring 2000 paces in circumference at its base, is supposed to be another. Others measure 40 feet by 50, and there are estimates specified of cubic contents of some running from 1200 to 2250, 10,296, and 27,000 cubic feet, and of weights ranging from 680 to 2310 and 5400 tons. There is one in Sutton Common, Craven, of about fifty yards in circumference and ten yards in height, and those I saw off the coast of Malabar were large blocks of the size of ordinary buildings.

A fourth sign of glaciers are the moraines, or rubbish heaps, which have been thrown out laterally in the onward course of the ice. The moraines of past times appearing in the Alps denote the passage of glaciers of immense magnitude, compared with which those of the present day are mere pigmies. In Canada the ice has left a bed of drift from 500 to 800 feet in depth.

In hilly regions the depth which the ice has attained may be estimated. In Scotland the till has been seen at heights of 2300 feet, and the stones

* *A Journey to Ashango-land*, 1867, pp. 292-294.

embedded therein have left their marks upon hill-tops to elevations of 3500 feet. The erratic boulders have been met with there at all levels up to 3000 feet. On the Jura they lie to the height of 3450 feet above the sea. Norway has been under the pressure of ice estimated at a thickness of 6000 or 7000 feet, and in Connecticut it has been supposed to have attained in places that of 6000 to 8000 feet. When the ice coatings terminate in the ocean, masses are broken off by the action of the water and are sent adrift as icebergs, and some of these are of stupendous size. Capt. Ross met with one that had stranded in 61 fathoms of water which was supposed to weigh about thirteen hundred millions of tons, and Dr Hayes found one to the north of Melville Bay that was aground in water nearly half a mile in depth, the weight of which has been estimated at two thousand million tons. The glaciers of polar regions are considered to be from 3000 to 5000 feet in thickness. The vast area of Greenland, containing 750,000 square miles, is, with the exception of a little strip on its western shore, covered with ice. The antarctic continent is similarly buried under ice. Sir J. Ross sailed for 450 miles along its precipitous cliff of ice, which rose in places 180 feet above the water. From all these indications Prof. Geikie concludes that Scotland and the neighbourhood of the Jura must have been under the pressure of ice 3000 feet thick. The contiguous countries were of course similarly circumstanced. It must have taken long ages to accumulate and disperse such vast deposits, and Sir Charles Lyell raises the assumption that glacial epochs are to be measured by hundreds of thousands of years.

The visitations of the ice have been frequent, and between them a warm climature prevailed. Professor Geikie informs us that deposits of glacial till are found intercalated with stratified beds of sand and clay, these beds varying in thickness from twenty to forty feet,

and containing layers of peat and other vegetable remains, with bones of the extinct ox, Irish elk, horse, reindeer, and mammoth. Borings at the estuary of the Forth have disclosed four several deposits of till with stones, divided from each other by intervening beds of sand. Similar evidences occur in England, Scandinavia, and North America. Professor Newbury has described the occurrence of a regular forest-bed, intercalated among true glacial deposits, with bones of the elephant, mastodon, and great extinct beaver. Professor Geikie comes to the conclusion that there have been similar alternations of climate through all the older deposits, as low down as the Silurian beds. Mr Croll says there is evidence of at least three ice periods prevailing during the deposition of the Tertiary formations, and he says there are marks of their occurrence in the Cretaceous and Permian deposits. Professor Ramsay considers that there are ice-borne boulder beds in the Old Red Sandstone of Scotland and the North of England, as also in the Permian strata. Mr Milton informs us of such boulders being found in mines, at the depth of seventy-four fathoms or four hundred and forty-four feet below the surface. The coal formations indicate the like changes. "Every foot of thickness of pure bituminous coal," observes Professor Huxley, "implies the quiet growth and fall of at least fifty generations of *Sigillariæ*, and therefore an undisturbed condition of forest growth through many centuries." The coal seams are separated from one another by intervening beds of shale and clay-slate, the coal being evidence of high tropical fertility, and the shale and clay marking absolute sterility, and thus probably representing the intervention of glacial temperature. In Coalbrookdale there are ninety such alternations; the Saurbrücker coal, according to Humboldt, consists of 120 beds, besides many which are less than a foot in thickness; and the Cumberland, Durham, and Northumberland coalfield has 147 different strata, the

coal alternating with limestone, sandstone, and clay-slate; in the Hainaut (or Mons and Charleroi) basin, says Mr Prestwich, the coal measures are 9400 feet thick, containing 110 seams; in the Liège basin they are of 7600 feet, with 85 seams; and in Westphalia they are of 7200 feet, with 117 seams. The coal seams in Melville Island and other places in the arctic circle are evidences of alternations of climate in those parts. Shells indicating the warmth of the Mediterranean have been found in the Pliocene strata of England; such as belong to Senegal occur in the Upper Miocene of France; fossil palms and other tropical plants have been met with in the Lower Miocene strata of Iceland; specimens of hazel, poplar, alder, beech, plane, and lime appear in the Miocene of North Greenland within 12° of the pole, Spitzbergen, the banks of the Mackenzie River, and Bank's land; and remains of tropical palms, and fossil fruits of the cocoanut and custard apple, with tropical shells, are found in the Lower Eocene strata of the Isle of Sheppey. Professor Geikie comments on the long intervals of time necessary to have effected these changes. "The disappearance of a *mer de glace*," he observes, "which in the lowlands of Scotland attained a thickness of nearer 3000 feet than 2000 feet, could only be effected by a very considerable change of climate. Nor, when one fully considers all sides of the question, does it appear unreasonable to infer that the comparatively mild and genial periods, of which the inter-glacial beds are memorials, may have endured as long as those arctic or glacial conditions which preceded and followed them. We have a difficulty in conceiving of the length of time implied in the gradual increase of that cold which, as the years went by, eventually buried the whole country underneath one vast *mer de glace*. Nor can we form any proper conception of how long a time was needed to bring about that other change of climate, under the influence of which, slowly and imperceptibly, this immense sheet of frost melted

away from the lowlands and retired to the mountain recesses. We must allow that long ages elapsed before the warmth became such as to induce plants and animals to clothe and people the land. How vast a time, also, must have passed away ere the warmth reached its climax, and the temperature again began to cool down! How slowly, step by step, the ice must have crept out from the mountain-fastnesses, chilling the air, and forcing fauna and flora to retire before it; and what a long succession of years must have come and gone before the ice-sheet once more wrapped up the hills, obliterated the valleys, and, streaming out from the shore, usurped the bed of the shallow seas that flowed around our island! Finally, when we consider that such a succession of changes happened not once only, but again and again, we cannot fail to have some faint appreciation of the lapse of time required for the accumulation of the till and the inter-glacial deposits."

Various suggestions have been offered to account for the extremes of climate to which the earth has been subjected. Sir Charles Lyell has thought that the altered relations of land and water may have produced these changes, but in so saying this eminent geologist can scarcely have weighed all the conditions. It is obvious that to bury a country at one time under 3,000 feet of ice, and at another to cover its surface with a heavy growth of tropical plants, requires some far more potent agency than the distribution of its surrounding waters could occasion. Professor Geikie combats this view. A possible change of climature incurred in the progress of the whole solar system through space is another idea that has been offered. That we pass in this way through torrid and frigid regions is purely ideal, nor is it reasonable to suppose that these should be constantly alternating in correspondence with the necessities of the case as marked upon the earth's surface. The swaying of the poles in effecting what is

known as the precession of the equinoxes, is another suggested cause. This is a circular movement, the radius of which is commonly held to be of $23^{\circ} 28'$, accomplished in a period of 25,870 years. Colonel Drayson,* in view of strengthening this agency, maintains the radius to be of $29^{\circ} 25' 47''$, and the time 31,840 years. No doubt some change of climate must be induced as the earth in this movement alters its position relatively to the direction of the sun's rays, but would the variation be sufficient for the phenomena? We are told, and the circumstances appear amply to warrant the supposition, that the glacial epochs, in the magnitude of their results, must be measured by hundreds of thousands of years, but here a torrid, or an arctic temperature, if thus to be induced, would recur every 13,000, or at most 16,000 years; nor is the explanation projected as covering the whole conditions before us. Those who offer it aim only at changes affecting Europe to 50° , and America to 31° north latitude, while the reality is, though hitherto not observed or acknowledged, that we have to account for the equator being covered with ice as the polar regions are at this day, which the movement in question could not effect. Another cause for the climatic changes proposed is the variation in the ellipticity of the earth's orbit. The diameter of the ellipse is held to vary by $13\frac{1}{2}$ millions of miles, which means that the earth is at times $6\frac{3}{4}$ millions of miles nearer to the sun than at others, and a computation made by Mr Stone of the Greenwich Observatory for Sir C. Lyell, would show that it occupies 515,600 years to bring the earth from one extreme in this distance to the other. Every 1,031,200 years, consequently, the earth is nearer or farther away from the sun by the said $6\frac{3}{4}$ millions of miles, and has travelled back again to the said extreme points. Here we have certainly the element of time for the periodical

* *The last Glacial Epoch of Geology.*

climatic changes in what approaches apparent sufficiency, but will the earth's altered position in its orbit induce the requisite variations of heat and cold? Professor Geikie, in adopting this movement as a cause of the changes of climate that are in question, admits "that mere proximity to the sun will not necessarily produce a warm season." We see in fact that it does not do so. The sun is not situated centrically to our orbit, and in our annual course we are therefore at times nearer to him, and at others more distant, and it happens that when nearest to him it is mid-winter, and when furthest from him mid-summer. The heads of the Himalaya and Andes are nearer to him than their bases, but the result is that the tops of these mountains are covered with perpetual snow, while a tropical temperature rules at their feet. This circumstance demonstrates that atmosphere is an essential instrument in conducting heat to the earth's surface; when dense the heat is freely imparted, when rarified it is dissipated. The mere alteration therefore of the earth's distance from the sun as the ellipticity of its orbit is altered, would induce no variation of climate, the change being effected in a space void of atmospheric properties. Professor Geikie suggests that the two movements last discussed, namely, the precessional gyration of the earth's poles, and the alteration in the ellipticity of its orbit, combine together to effect the extremes of heat and cold to which the same parts of the earth are at different times subjected. It is not apparent how movements with such vastly differing periodicities can act in unison for their results, nor does the Professor here explain himself. The need to make use of both these movements to account for the phenomena in view, amounts to an admission that singly neither of them is adequate for the purpose. Nor would these movements disturb the existing alternations of summer heat and winter cold, so that the extremes of temperature would still annually succeed each other, over the parts that are in question,

and not be maintained continuously as the exigency requires.

The true way to account for natural phenomena the immediate cause of which is not apparent, is to presume that what occasions the like effects under circumstances open to our observation, must be that which has produced the same results in the instances remaining to be judged of. The disturbances to which the planet Uranus was subjected led to the discovery of the planet Neptune. It was known from the conditions of the spheres in view that their approaches towards each other in their courses induced such perturbations, and this caused a search to be made for the unseen sphere whose presence was necessary to account for the deflections of Uranus, and thus the existence of Neptune was brought to light. It is observed how through atmospheric and other causes rocks and hill-sides are worn down, and their debris cast upon the lower levels; how these lower levels are washed away by surface waters; how still heavier drifts are effected by fluvial operations; and how sediments in ocean-beds or lake bottoms are accumulated; and we become satisfied that the strata composing the earth's crust, layer upon layer, must have been brought together and deposited by similar agencies in the past ages. The various circumstances that are connected with the existing glaciers—the till, the scorings of the rocks, the erratic boulders, and the lateral moraines, where they occur, prove to us that glaciers have occupied the land where now no ice can hold its ground. The conclusion should follow, as an inevitable consequence, that the conditions which have produced and maintain the ice coatings in the present day, must be those which produced and maintained them when ice similarly prevailed elsewhere in the bygone ages. That is, the conditions which have induced the heavy coating of ice with which Greenland is at this moment covered, are those that were present and operated in former times when the low-lying parts

of equatorial India and Africa were buried under the like glacial covering ; and we should be equally assured that the circumstances which cause the growth of tropical vegetation in the warmest portions of the globe, are the same which brought about similar growths in Melville Island, Baffin's Bay, and other regions near the pole, where coal formations, the product of such growths, are found.

It is evident that the extremes of heat and cold witnessed in various places on the earth are due to the positions of those parts relatively to the sun, his rays falling in the warm regions vertically, or nearly so, and in the cold regions very obliquely or for seasons not at all. We should be prepared then to recognize the necessity that to induce tropical growths near the pole, and heavy domination of ice at the equator, the relative positions of the earth and the sun must have been other than they now are, and that there have been times when the sun's rays fell vertically at the poles and obliquely at the equator.

It is necessary to apprehend in what manner the earth undergoes that diurnal revolution which constitutes it a globe revolving on an axis. No one will be prepared to deny that the power, whatever its description, is one exerted upon it by the sun. Magnetism, which the sun indubitably sheds upon the earth, would effect such a movement. Baron Reichenbach informs us that the sun's rays will restore the power of a weakened magnet, and have converted an iron key into a magnet. Mr Proctor, citing General Sabine, says that the magnetic action, connected with the earth, varies according to the earth's propinquity to the sun, being intensified in both hemispheres in December and January, when its orbit is nearest to the sun. Magnetic disturbances or storms are now traced to solar agency, and the aurora is also associated with the same agency. An iron vessel will exercise a different effect upon its compass according as it has been constructed

in the line of the magnetic poles, or north and south, or of the magnetic equator, east and west. The vessels have thus become magnetic according to the direction in which they have been exposed to the sun's influence. Professor Tyndall notices that magnetic currents will set a body in rotation, exercising a repulsive force which drives the object in one direction while an attractive force draws it round in the opposite line. A correspondent of mine has verified these circumstances in illustration of the sun's operation upon the earth. He says, "one of Faraday's experiments I have myself made in model. A round ball of wood floats in water, with an iron wire through its poles. This wire has been made magnetic in the ordinary way, so that it has a north and south pole. The ball and its poles now represent the earth floating in space. By means of an electro-magnet at some little distance from it, the ball can be made to rotate on its axis." Humboldt, citing Halley, states that there are four magnetic poles on the earth's surface, a representation which Mr Proctor endorses. These are situated north and south of the equator, at positions removed therefrom by from 70° to 75° , and lie about 80° on each side of the axis of the earth's rotation. There is thus a broad belt of magnetism reaching the earth's surface, prevailing as far as its spherical form will arrest the magnetic current, and directed towards it in the line of its axis, by means of which it may be presumed the earth's diurnal rotation is effected or promoted. Mr Crooke's discovery that light has a motive power introduces another equally potent agency, it being apparent that as his disks revolve in an exhausted receiver by means of the light of a candle, so will the earth poised in space revolve under the powerful action of the sun's rays.

Such being the circumstances under which it may be presumed the earth is made to rotate upon its axis, namely, by the means of power, magnetic and luminous, cast upon its surface by the governing orb, the sun, in

the direction of its axis, it requires but an alteration in this line of action to effect those great climatic changes that have to be accounted for. If this line of action slowly moves from its present position, passing from the direction of the poles to that of the equator, the polar regions become equatorial and the equatorial polar, and as it completes its circuit these regions return to their former conditions. Thus may be brought about all that we have seen to have occurred upon the earth's surface, tropical plants raised in the polar regions and ice dominating in the equatorial, nor does it seem reasonable to assume that these effects have been induced in any other manner.

The sun, it must be remembered, is a moving body, liable to disturbances from other spheres outside of it, equally as is the earth. That is, it revolves on its axis, taking twenty-five days to effect the revolution, and it is believed to be in progress round some very distant centre. There are thus systems within systems belonging to the heavenly orbs, each under its proper governance. The satellites are specially associated with the planets that possess them, and are held circling round their respective governors; the planets, with their satellites, are similarly held circling round the sun; and the sun, with its attendant orbs, is apparently holding a like course round its distant governor. The planets are liable to disturbances from the influences of the bodies associated with them as these approach them. The earth has various indications of experiencing such disturbances. It is swayed at its poles, whereby the precession of the equinoxes is effected; this movement is made in a nutatory or waving line; the earth's circuit round the sun is elliptic and not circular; its position is not central to this ellipse; and the diameter of the ellipse is continually changing; furthermore, a constant alteration in the angle of the ecliptic shows the earth to be ever undergoing a geographical change relatively to its path round the sun. There is then no

improbability, but on the contrary a likelihood, that the sun is in a similar manner affected by orbs with which it may be associated in regions beyond our system, and some consequent disturbance to which it may be thus subjected might alter the direction of its radiation towards the earth in the manner contemplated as that bringing about the climatic changes which are in question.

That astronomers have not detected such a variation of the polar axis should not be conclusive against its occurrence. We may be said to be still in the infancy of science. It is not three hundred years since Galileo was denounced by every astronomer in Europe for maintaining that the earth revolved daily on its axis. The nutation of the poles at the precessional movement was first noticed by Bradley two hundred and twenty-eight years ago; the planet Uranus was discovered by Herschel less than a hundred years ago; it is but thirty years since Adams detected the existence of Neptune; and at the beginning of the current century but seven minor planets circling between Mars and Jupiter were known of, and their number now is found to exceed a hundred, and is constantly being added to. The nutation of the poles, their precessional gyration, the variation in ellipticity of the earth's orbit, and the change in the earth's position indicated by the alteration of the angle of the ecliptic, are all circumstances disturbing the earth's relative position towards the sun which would interfere with close observation of the movement of the polar axis that is in question. The conditions, namely, the long maintenance of the ice where it prevails, and of tropical heat where that exists, necessitate that this movement should be a very slowly executed one, and it would take long intervals, between accurately recorded observations, to establish such a movement. It is possible, therefore, that in the course of time it may yet be ascertained.

I here introduce a communication received by me in respect of the present production, from a scientific

friend to whom I am already under deep obligations for aid in following out the theory connected with the changes of climature the earth has undergone, which I have ventured to advance. He says,—

“The grand movement of the earth’s mass* originating primarily from the sun which is here sought to be established to account for the climatic changes everywhere evident upon its surface, cannot at the present day be clearly proved by astronomy, inasmuch as the change alluded to occupies or involves probably millions of years during only one revolutionary cycle. To detect so slow a change by merely optical observations, involving errors of refraction of light, in so short a period as two or three hundred years, is not to be expected. We have no certain method even at this moment to tell within 8" or 10" what the refraction of the air really is, and also it varies at different times, so that to fix the precise position of any part of the earth’s surface astronomically with sufficient accuracy to detect the small movement referred to, would be to imply the non-existence of all disturbing influences. Even the parallax (the difference between the real and apparent place) referring to any of the heavenly bodies is by no means correctly ascertained. This of course involves most important results. For mere approximation of stellar distances it is accurate enough, but what is now in view is an exceedingly slow motion of the mass of the earth corresponding with that of the sun, leaving the rotation of the two bodies still at their natural angle—which as far as our observations extend has not yet been detected. To prove how easily so small a quantity has been overlooked: in the most ordinary observations for transit, it is usual to allow for what is called a personal equation, that is one man

* This is not as I have expressed the suggested movement. I take it to be an alteration of the polar axis relatively to the earth, and not a movement of the mass of the earth relatively to the polar axis. My correspondent concedes that the case may be as I have stated it.

looking through the same transit instrument will not see the sun or a star pass his centre wire at the same instant of time which another will do with equally good eyesight. It is therefore obviously inaccurate to cite the merely optical measurements of astronomy as any argument against the slow change of the earth's surface here asserted in unison with that of its primary the sun. In hundreds of years hence it will probably be detected. Several astronomers have lately hinted at the probability of such a movement.

“The late observations to ascertain the sun's parallax, or, in other words, his mean distance from the earth, by the transit of Venus over his disc, although taken in all parts of the globe, so far as we yet know of them, are singularly discrepant. The French astronomers, with first-rate instruments, make the parallax 8".879. Our own deductions are not yet all published, but several of them show many decimals under this result. Therefore astronomy is not to be appealed to at present in the face of geological facts, and these being undeniable, remain for acceptance to the full measure of their value.”

The contemplated change in the axis of rotation involves another circumstance, the bearings of which have to be taken into account. A globe always revolves on its shortest axis. The earth now does so, the diameter from pole to pole being shorter by a little above $26\frac{1}{2}$ miles than the diameter at the equator. The crust of the earth is known to be elastic, being subject to continual upheavals and depressions, and especially at the equator, so that every portion of the globe has been under water, or raised up out of the water, becoming at one time sea bottom, and at another dry land, and its surface, whether below or above the water, is ordinarily undulating and diversified by high and low levels, forming the hills and valleys which are before us. The bulge of the earth at the equator is attributed to the centrifugal force violently operating in that direction as the globe whirls in space in effecting

its diurnal revolution. It follows if the axis of rotation is varied, the equator is correspondingly varied, and the new region becoming equatorial is subjected to the high degree of centrifugal force exerted in that direction. In this way there would be a constant change effected in the form of the earth as the line of its axis of rotation underwent alteration, and the conditions would be maintained of the shorter diameter in the line of the axis, and the longer one in that of the equator.

The reasonableness of the solution offered will better appear upon reducing the proportions of the earth to dimensions that the mind can easily appreciate. The crust of the earth, judging from the known stratifications is supposed to measure about twenty miles. Let this be expressed by one inch, when the earth may be represented by a globe about thirty-three feet in diameter. It is quite conceivable that the thin elastic crust of such a globe would yield to the pressure of great force continually acting at its centre, so that its diameter in that quarter might be distended by about an inch and a quarter, which is all that the circumstances before us require. But as this crust is also persistent, brittle, and fragile, the operation could not be effected without leaving marks of the exerted force, and these indications actually do appear. The strata originally laid down horizontally by deposition in water, are twisted and turned in every direction, and the more so the lower down they are situated, and in mines, whether of coal or of metals, the seams or veins are invariably broken through, the fractures often occasioning in the metallic mines the loss of the lode that has to be followed up, it being difficult to discover where the severed portion has been left. These faults, as they are termed in mines, are sure to occur at sufficient depths. The process of the equatorial distention is, it must be assumed, maintained continuously, and as the same portion of the globe is brought repeatedly to undergo it, it follows that the deeper we penetrate the

earth's crust the more will there be evidence of its disturbance. The marks of violence that the crust of the earth exhibits, and the constant alteration effected in its levels, are thus circumstances necessarily to have occurred under the polar movement contemplated. The theory offered of the change in the direction of the axis of the earth's rotation may hence be seen to embrace all the conditions which it should cover, nor has any other solution yet been proposed that can be admitted as affording a satisfactory explanation of the observed phenomena.

There are other features which illustrate the movement in question, and which at the same time afford the means of rebutting Archdeacon Pratt's conclusion that there have been two distinct creations, an ancient and a modern one, and that the latter period, having man connected with it, is to be confined within the limits of 6000 years. These are the cave deposits, and especially those of Kent's Cave, near Torquay, which I will proceed to trace out.

The explorations in Kent's Cave have been conducted under the supervision of a Committee of the British Association since the year 1865, two of the body being the well known geologists Messrs Vivian and Pengelly, whose reports are annually laid before the public through the medium of the Association. In this cavern are six distinct deposits, namely (1) of back mould forming the surface floor of the cavern; (2) a floor of granular stalagmite; (3) a stratum of red cave earth; (4) a floor of crystalline stalagmite; (5) a stratum of brown rock-like breccia; (6) another floor of stalagmite. The bottom of the cave has, in most parts of it, not yet been reached. The soft or granular deposit of stalagmite, forming the second in the above series, remains intact as originally laid down; the next floor of stalagmite, which is hard and crystalline, is in parts undisturbed, and in parts has been broken up into large fragments which have been in places forced through

the three superior strata, and thus sometimes exhibit themselves at the surface floor of the cave; the rock-like breccia and the third floor of stalagmite have both been broken up. The stalagmite formations which have thus suffered run to several feet in thickness, in some places to as much as twelve feet, and are thus of great density and strength, and through all these deposits are large blocks of the solid rock of the cavern that have been from time to time torn from its sides and roof. The present condition of the cavern is quite sound, not a splinter being detached within it by the heavy blastings that occur. The question arises, What has led to the recurrent floors of stalagmite and to the disruptions of the stalagmite and of the rocky lining of the cavern?

The stalagmite floors are formed by the dropping of water through the limestone roof, which slowly deposits the lime below. Something must have occurred to have arrested the drip at the completion of one of the floors, and to have set it free again for the formation of another floor, and from the extent of the intervening accumulations of cave earth or breccia, the period of the interruption must have been a lengthened one. The phenomenon, it is apparent, is due not to a local but a general cause, for there are distinct floors of stalagmite in other caverns; for example, there are two in the Windmill Hill Cave at Brixham, also in Poole's Cavern Buxton, in the Caves of the Wye, and in the Trou de la Naulette, near Dinant, in Belgium. The recurring glacial and warm periods which visit the earth at once account for what has happened. When the cave has passed into the icy temperature, the drip has been frozen up and arrested, and when it has passed into a sufficiently warm temperature, the drip has been let loose, and the formation of a fresh floor of stalagmite has ensued. The breaking up of the stalagmite floors, and the disruption of the rocks within the cave, are just what would occur when the cavern entered into the

equatorial region and became subjected to the violent distention in that quarter effected by the centrifugal force there in operation. The Committee who are exploring the cavern say that some power like that of an earthquake has been necessary to cause the disruptions in question, and the polar changes contemplated would introduce just such a power. The upper floor of stalagmite can have passed but once under the pressure at the equator, and being soft and yielding has not suffered in the process. Time has altered the consistency of the second and third floors, and made them hard and unyielding, as is the condition of the compacted breccia between them; these have been equatorial more than once, and the pressure upon them which twists the strata of the earth and snaps solid beds of coal across, has sufficed to break them up. The same cause has also splintered off the rocks within the cavern, and left masses thereof occupying every stage of its deposits.

Cape Farewell, or the southern point of Greenland, stands in about 60° N. Lat., and Disco Island, off the western coast of Greenland, in about 70° N. Lat. The glacial line may be said to lie midway at about 65° .* In the entire circle, consequently, there would be two sections at the North and South Poles, measuring about 50 degrees each where ice would prevail, and between them would be two regions of warmth, temperate and tropical, measuring about 130 degrees each. The cavern may be supposed to have been in a position relatively to the sun corresponding to 65° S. Lat. on the Eastern hemisphere when the third, or lowest floor of its stalagmite, began to be formed, the same being completed when the cave reached a position corresponding to 65° N. Lat. Then it may be presumed a glacial epoch ensued,

* Capt. Bach says that the sub-soil, twenty inches below the surface, is perpetually frozen in latitude 64° North (*Narrative of Arctic Land Expedition*, p. 479.)

and the drip was frozen up and ceased till the cave, passing across the pole, came to be in a position corresponding to 65° N. Lat. on the Western hemisphere, when the drip was resumed and the second floor formed. After that must have occurred another glacial epoch, till 65° S. Lat. on the Eastern hemisphere again became its position, when the first or uppermost floor now in course of completion began to be formed. The cave would seem thus to have experienced two seasons during which ice dominated, and three (the last not yet concluded by the measure of about 15 degrees), during which warmth, temperate and tropical, prevailed. The animal remains, which are found chiefly in the cave-earth intervening between the superior and the second floors of stalagmite, denote the passage of the cave through these various climates, there being those of the ox, horse, sheep, deer, hare, rabbit, pig, rat, fox, wolf, badger, bear, and beaver to mark the prevalence of a temperate climate, those of the hyena, elephant, lion, and rhinoceros to show a tropical climate, and those of the reindeer to indicate an arctic climate.

It would have been interesting had the Committee afforded the means of judging what the periods may have been that have been requisite for the formation of the floors of stalagmite, and so of estimating the time that may be occupied in effecting a complete revolution of the polar axis. But though they have not ventured upon any such calculation, they give us grounds of assurance that the periods in question have been very lengthy ones. At one spot where a former explorer cleared away the stalagmite twenty-eight years ago, a constant drip has left a formation, covering a few inches only, to the thickness of writing paper. At a place called *The Crypt of Dates* are inscriptions of names and initials cut into the stalagmite by visitors, with dates reaching back to 1618, and yet after a lapse of two centuries and a half, in a region where the drip is un-

usually copious, and the stalagmite, consisting of the superior and second floors, here brought together, is above twelve feet in thickness, these letters, which it is supposed were never more than an eighth of an inch in depth, remain still unobliterated. At another place called *The Arcade*, there is a boss of stalagmite measuring forty feet in circumference, and fully thirteen feet in height, on the upper part of which is an inscription of the year 1604, the condition of which shows that the stalagmite "has undergone no appreciable augmentation of volume" during the period of more than two and a half centuries that has gone by. Mr Vivian, in a paper of his on the evidences of Glacial Action in South Devon, referring to a place in Kent's Cave called *The Cave of Inscriptions*, containing names and initials on the stalagmite, one of which is of the year 1688, suggests that the rate of deposit thereupon may have been "one-tenth of an inch" "during each one thousand years." He does not give the thickness of the stalagmite at this spot, but supposing his rate may be applicable to the twelve feet of stalagmite at *The Crypt of Dates*, the period required for that accumulated deposit would be 1,440,000 years.

The glacial phenomena have been traced by geologists through the Tertiary and all lower strata down to the Silurian formation, and here in Kent's cavern is apparent proof that in the modern period in which the cavern stands have occurred two glacial epochs. Thus, in correspondence with other abundant indications of a like tendency, we have evidence of the continuity of the creative processes, and that there has been no such interruption thereof as Archdeacon Pratt calls for in order to establish his idea that there have been two distinct creations, an ancient and a modern one; and the vast time that must have been occupied in forming the stalagmite floors of the cavern, three in number, with interruptions between the periods caused by the domination of ice, puts an end to the supposition by

which he is bound, that what he terms the modern creation can possibly be brought within anything like the limits of six thousand years.

The duration of man upon earth, hundreds of thousands, and it may be millions of years, beyond the period marked out in Genesis, is also apparent from the same quarter. The upper floor of stalagmite in Kent's Cave contains, with the remains of extinct animals, palæolithic flint implements and charred wood, and in a portion twenty inches in depth in this deposit have been found a human tooth and portion of a jaw-bone containing four teeth. In the cave-earth below have been discovered similar flint and chert instruments, burnt bones, charred wood in great quantities, and "bone tools and ornaments, consisting of harpoons for spearing fish, eyed needles or bodkins for stitching skins together, awls, perhaps, to facilitate the passage of the slender needle or bodkin through the tough thick hides, pins for fastening the skins they wore, and perforated badger's teeth for necklaces and bracelets." In the breccia, below the second floor of stalagmite, which is described to be in places upwards of twelve feet in thickness, have been found fifty-six flint and chert implements and flakes, together with numerous teeth of the cave bear, five teeth and a portion of the skull of the lion, and the jaw of a fox—the remains of the hyena, with his coprolites, which abundantly appear in the superior cave-earth, and the bones of the various animals which he may have there dragged in, not occurring in this more ancient deposit. "A glance," it is said, "at the implements from the two deposits," (the cave earth, and the breccia), "shows that they are very dissimilar. Those from the breccia are much more rudely formed, more massive, have less symmetry of outline, and were made by operating, not on flakes purposely struck off from nodules of flint or chert, as in the case of those from the cave-earth, but directly on the nodules themselves." A great age, the Committee

conclude, has intervened between the two eras with their distinctive deposits, tools, and men; one particular massive implement they specify, measuring 4·5 inches by 3 inches, as the finest and the oldest specimen in the breccia, and this was met with four feet down in this very ancient and solid deposit.

The evidence for the antiquity of man afforded by Kent's cave is consonant to what appears in other directions. Just such remains of men and animals occur in other limestone caverns below their stalagmite floors. So far back as the year 1774, human bones and fragments of rude pottery, with bones of bears and hyenas, were found in such a position in caves of Gailenreuth in Franconia; in a similar position, under a dense crust of stalagmite, Dr Schotte and Baron von Schlotheim met with human bones, some of which were eight feet under the remains of a rhinoceros, in the caves of Kostritz in Upper Saxony; in a breccia floor, below cave-earth and stalagmite, in the Caverne de Chauvaux, near Namur, Belgium, Professor A. Spring discovered five human jaw-bones, a parietal bone, and a flint hatchet, in contact with remains of the eland, auroch, and other animals; and in sandy clay, three metres and a half below the second floor of stalagmite in the Trou de la Naulette, Belgium, were found a human jaw-bone, two teeth, and an arm-bone, with the fragment of a reindeer horn, which had apparently been bored by some sharp instrument.

Archdeacon Pratt, as his theory made imperative on him, disputes the fact that vestiges of man have existed in the Tertiary deposits, but there are certainly seemingly reliable statements, showing that they have there appeared. Mr James Watson is reported to have discovered portions of a human skull at Altaville, near Angelos, Calaveras county, California, in a stratum of undisturbed Tertiary, at a depth of 130 feet, in a mining shaft; M. Desnoyers and the Abbé Bourgeois are said to have found bones of the elephant and rhinoceros,

with figures of animals engraved thereon, in the upper Pliocene strata at Prest, near Chartres; in a similar deposit at Calle del Vento, near Savona, M. Issel, and in the still deeper Miocene at Selles-sur-Cher (Loire-et-Cher) the Marquis de Vibraye, are said to have discovered bones in like manner exhibiting the figures of animals engraved on them; and in 1873, Mr Frank Calvert made known, through Sir John Lubbock, that from a cliff of the Miocene period, in the vicinity of the Dardanelles, he extracted a fragment of the joint of a bone of the dinotherium or mastodon, measuring nine inches in diameter and five in thickness, with the figure of a horned animal deeply incised thereon, and traces of seven or eight other figures which were nearly obliterated, as also a flint flake and some bones of animals that had been "fractured longitudinally, obviously by the hand of man for the purpose of extracting the marrow, according to the practice of all primitive races." Mr Calvert concludes from his own and other such like discoveries, that it is "established beyond a question that the antiquity of man is no longer to be reckoned by thousands, but by millions of years."

With the statement in Genesis, in respect of the period when the world was formed and occupied by the human race, thus violently overthrown, the whole scheme of artificial religion prevailing in Christendom falls to the ground. The history of Adam, biblically given as that of the first man, is an essential feature in this scheme. If he disappears, or was not the first of the race, the tale of what happened in the garden of Eden is made void; and the circumstances narrated to account for the introduction of sin into the world becoming unreal, equally unreal must be the special provision offered to our acceptance as made for the sin. If we have to do away with the first Adam, it is impossible to retain upon the scene the second Adam who was to replace him. The latter is derived from

“Enos which was the son of Seth, which was the son of Adam, which was the son of God,” but if there was no such root for man as this Adam, created but 6000 years ago, and the family have really been in existence hundreds of thousands, and it may be millions of years, and have sprung from some other stock, the genealogy proves to be a nullity, and the personage in whose favour it has been constructed, in the position asserted for him, becomes in like manner removed from the field of fact. And thus knowledge, based on possession of the actualities, always puts an end to fiction, or the imaginative representations of the ignorant.

