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ORDINARY MEETING, FEBRUARY 17, 1868.

CAPT. E. G. FISHBOURNE, R.N., C.B., HON. TREASURER, IN THE CHAIR.

The Minutes of the previous Meeting were read and confirmed; and the names of the following new members and associate were announced, viz. :—

MEMBERS :—H. Cadman Jones, Esq., Barrister-at-law, late Fellow of Trin. Coll., Cambridge, 4, Old Square, Lincoln's-Inn Fields; Rev. Archibald Macmillan, 6, Westbourne-Park Place; Rev. Lewis Barrett White, M.A., the Rectory, 67, Queen Street.

ASSOCIATE, 1ST CLASS :—Miss Dudin Brown, Alexandra Hotel, Knightsbridge.

The Rev. WALTER MITCHELL then read the following paper, which he had previously read at Sion College, in reply to Professor Huxley's address, delivered there on the 21st of November last :—

ON THE UNPHILOSOPHICAL CHARACTER OF SOME OBJECTIONS TO THE DIVINE INSPIRATION OF SCRIPTURE. By the Rev. WALTER MITCHELL, M.A., *Vice-President.*

THE President of Sion College was pleased to invite a distinguished professor to give the clergy connected with that college an account of the supposed great divergence of thought between men of science and the clergy. We were told upon that occasion by Professor Huxley that the evidence afforded by the Nile mud and the facts disclosed by geology were such that no scientific man or duly instructed person could believe in the truth and divine inspiration of the works of Moses. I propose now, First, to sift the evidence by which the vast antiquity of man is sought to be proved, and to demonstrate its unscientific character and perfect worthlessness :—

Secondly, to show that the progress of geology has been retarded by the unphilosophical manner in which the precepts

of Bacon have been disregarded; that when that science is freed from the fetters of "feigned hypotheses," it tends to prove the accuracy and truthfulness of Moses:—

Lastly, that the great divergence between some professors of science and the clergy, produced in reality by the denial of creation, arises from no true progress of science. That it has been caused by the importation of the rationalistic principles of Strauss into the domain of physical science. That it rests on no philosophical basis, and is only the product of imaginary hypotheses unfounded on fact. The first question I propose to investigate is the scientific evidence adduced in support of a far higher antiquity for the human race than any that can be derived from Holy Writ.

According to Hales's chronology, man was created 7,279 years ago, and according to Ussher 5,872 years only have elapsed since that event. The discrepancy between these two distinguished chronologists may be taken as a proof how very difficult it must be to derive an accurate chronology from the data given in the Bible. It is asserted, however, that there is good scientific evidence to show that civilized man has existed in Egypt 30,000 years, and that man inhabited the banks of the Mississippi 50,000 years before the present time. Surely, we are told, it must be admitted that no stretching of the Bible chronology can be made to include such vast periods.

Sir Charles Lyell's *Antiquity of Man* is so extremely vague in its statements of the scientific methods by which this great antiquity is arrived at that we must have recourse to some more definite authority to investigate the scientific value of the methods by which this problem is determined. In the *Philosophical Transactions* for 1855 there is a paper by Mr. Leonard Horner, Vice-President of the Royal Society, and Vice-President of the Geological Society, in which he seeks to prove, by strictly scientific methods, that civilized man existed in Egypt 13,371 years before A.D. 1854. He states,—

"In accordance with the opinion I entertained when I undertook the inquiry that excavations should be made in the vicinity of some very ancient monument, the age of which is known, I chose the site of the long-extinct city of Memphis, now covered with the date-groves of the modern village of Metrahenny, twenty miles above the parallel of Heliopolis, and about thirty miles above the apex of the Delta. All testimony appears to concur as to its very remote antiquity, in assigning its foundation to Menes, the first king of the first dynasty which reigned over Egypt, and who, according to Lepsius, the latest and very able expounder of Egyptian chronology, began his reign 3,892 years before the Christian era."

But one solitary monument of the former greatness of Memphis remains. About forty years ago Signor Caviglia, observing some indications of buried sculpture between the modern villages of Metrahenny and Bedreshin, made an excavation about five feet deep, and uncovered the whole length of a colossal statue. On this statue there are hieroglyphics, by means of which Mr. Bonomi determined that it represented Rameses II., the Sesostris of the Greeks. Mr. Horner quotes Herodotus, as saying

"That Sesostris erected two statues, each 30 cubits high, before the temple of Vulcan in Memphis, representing himself and his queen, and four statues of his sons, each 20 cubits high."

The uncovered statue Mr. Horner believes to be the statue of Sesostris spoken of by Herodotus. He wrote to Dr. Lepsius to assign a date to it, and received this reply :—

"If we may assume that the Memphis statue represents Rameses while a young man, of which the absence of the beard would not be, of itself, a decided proof, we should then be justified in assigning it to the beginning of the 14th century before Christ. According to my estimate, Rameses Mianun reigned from about 1394 to 1328 B.C."

Having thus obtained a monument of assumed known age, Mr. Horner, through the influence of the Hon. Charles Murray, then Consul-General in Egypt, induced the Egyptian Government to cause a number of pits to be sunk, partly by excavation and partly by boring, in the immediate vicinity of the fallen statue. Mr. Horner was not present, but all the operations were carried out by Hekekyan Bey, an Armenian officer of engineers, who had received a scientific education in England.

The depth of mud accumulated above the base of the pedestal of the statue, assuming that mud to have commenced to accumulate from the time that the statue was erected, was taken as affording a just estimate of the secular rate of increase of the Nile mud at this spot.

"In the excavation at this statue in the area of Memphis in 1852, the level of the upper surface of the platform on which the statue had stood was ascertained to be 5 feet 8 inches below the surface of the ground; but as there were eight inches of a sandy earth, there remained five feet of true Nile sediment. The upper blocks of the platform are 31¼ inches thick, and the lower 35½ inches; together 5 feet 6¾ inches. If we allow the lower part of the platform to have been 14¾ inches below the surface of the ground at the time it was laid, we have a depth of sediment from the present surface of

the ground to that level of 9 feet 4 inches. Rameses, according to Lepsius, reigned from 1394 to 1328 B.C., and if we suppose the statue to have been erected in the middle of his reign, *i.e.* in 1361, we have between A.D. 1854 and that time 3,215 years, during which the above depth of 9 feet 4 inhces of sediment was accumulated ; and, supposing that no disturbing cause had interfered with what may be termed the normal rate of deposition in this locality, and of which there is no evidence, we have thus a mean rate of increase within a small fraction of $3\frac{1}{2}$ inches in a century."

In this way Mr. Horner determined the first step in his problem, the mean rate of the deposition of Nile mud at the base of the statue. At a depth of 39 feet from the surface a fragment of burnt brick was obtained. This enables Mr. Horner, as he supposes, to determine a period at which civilized man inhabited the valley of the Nile.

"In a large majority of the excavations and borings," says Mr. Horner, "the sediment was found to contain, at various depths, and frequently at the lowest, small fragments of burnt brick and pottery. In the lowest part of the boring of the sediment at the colossal statue in the year 1854, at a depth of 39 feet from the surface of the ground, consisting throughout of true Nile sediment, the instrument brought up a fragment of pottery, now in my possession. It is about an inch square and a quarter of an inch in thickness, the two surfaces being of a brick-red colour, the interior dark grey. This fragment, having been found at a depth of 39 feet, if there be no fallacy in my reasoning, must be held to be a record of the existence of man 13,371 years before A.D. 1854, reckoning by the before-mentioned rate of increase in that locality of $3\frac{1}{3}$ inches in a century, 11,517 years before the Christian era, and 7,625 years before the beginning assigned by Lepsius to the reign of Menes, the founder of Memphis ; of man, moreover, in a state of civilization, so far, at least, as to be able to fashion clay into vessels, and to know how to harden it by the action of a strong heat.

"In the pit marked No. 6 in the ground-plan, at page 62, which was 354 yards north of the colossal statue, at a distance of 330 yards from the river, fragments of pottery were found at a depth of 38 feet from the surface of the ground.

"Fragments of burnt brick and of pottery have been found at even greater depths in localities near the banks of the river, 10 and 16 miles below Cairo. In the boring of Sigiul, described in page 64, under the number 26, fragments of burnt brick and pottery were found in the sediment brought up from between the 45th and 50th foot from the surface ; and in the boring at Bessousse they were brought up from the lowest part, viz., 59 feet from the surface, but in this case in sand, the lowest sediment containing fragments of brick and pottery being at a depth of about 48 feet. I have also learned, from a communication with which I have been favoured by M. Linant de

Bellefonds (Linant Bey), that a few years ago he made a boring about 200 mètres (656 feet) from the river on the Libyan side of the Rosetta branch of the Nile, in the parallel of the apex of the Delta, and that he had found fragments of red brick at a depth of about 72 feet below the surface of the ground. But in these cases there was wanting the fixed point of known age, the indispensable requisite for the formation of a chronometric scale. I may, however, state that M. de Rozière estimates the mean rate of the deposit of the sediment in the Delta as not exceeding 2 French inches and 3 lines (60·907 millemètres = 2·3622 English inches) in a century."

I have given you, though at the risk of being thought tedious, the exact words in which Mr. Horner solves his problem for determining the age of man in Egypt. First, because of the importance still attached to this problem; secondly, because I can find no other attempt to solve the problem of man's age by means of mud-deposits approaching to anything like the scientific accuracy sought to be attained by him. We have plenty of dogmatic statements that Nile mud or Mississippi mud accumulates at such a mean rate per century, but no proof or even statement of the methods by which that rate is determined.

Such a multitude of assumptions are made by Mr. Horner in accumulating the data for the solution of his problem that the most superficial consideration of it must lead us to suspect some great fallacy in his reasoning. Is there any real proof of the date of the colossal statue? Some assert that Egyptologists cannot interpret hieroglyphics, and maliciously compare translations of the same hieroglyphical inscription, by two equally eminent translators, which do not agree in a single word, and are most opposite to each other in sense. But taking for granted that the inscription is rightly read as that of Rameses II., what proof is there that it was erected in his reign? When the future New Zealander speculates on the date of the statue of Richard I. now standing at Westminster, will he be right in assuming that it was erected in the middle of his reign?

If it be the statue spoken of by Herodotus, where is the colossal statue of the wife and the two colossal statues of the sons? Why have these disappeared without a trace, leaving only that of the king? Again, do not many distinguished Egyptologists differ from Lepsius in his chronology?

What says Sir G. Cornewall Lewis, in his *Astronomy of the Ancients* (p. 370), about the estimate of Lepsius, that Sesostris or Rameses Mianun reigned from about 1394 to 1328 B.C.?—

"Lepsius agrees with Bunsen that Sesostris on the Manethonian list, who stands in the 12th dynasty at 3320 B.C., is not Sesostris, but, instead of ele-

vating him to the 3rd dynasty, brings him down to the 19th dynasty, and identifies him with Sethos, 1326 B.C., chiefly on account of a statement of Manetho, preserved by Josephus, that Sethos first subjugated Cyprus and Phœnicia, and afterwards Assyria and Media, with other countries farther to the East. . . . We therefore see that the two leading Egyptologists, Bunsen and Lepsius, differing in other respects, agree in thinking that Sesostris is not Sesostris. . . . But here their agreement stops. One assigns Sesostris to what is called the old, the other to what is called the new empire, separating his respective dates by an interval of 3,793 years. What should we think if a new school of writers on the history of France, entitling themselves Franco-logists, were to arise, in which one of the leading critics were to deny that Louis XIV. lived in the 17th century, and were to identify him with Hercules or Romulus, or Cyrus, or Alexander the Great, or Cæsar, or Charlemagne, while another leading critic of the same school, agreeing in the rejection of the received hypothesis as to his being the successor of Louis XIII., were to identify him with Napoleon I. and Louis Napoleon?"

Baron Bunsen eagerly accepted Mr. Horner's conclusions, which fitted his elastic chronology with sufficient accuracy, and formally adopted them in the third volume of his *Egypt's Place*, &c. This gave the *Quarterly Review* for April, 1859, an opportunity of refuting Mr. Horner in the most crushing manner. The *Quarterly Review* pointed out that Mr. Horner did not see the fragments brought up from the borings; that any one who had any experience of Egyptian workmen knew well that they would easily produce pieces of brick and pottery when once they discovered that such common things were all they were required to seek for. Assuming, however, that the fragments were really brought up from the depths of forty feet, there might still be great doubts as to their assumed antiquity.

"According to an ancient tradition" (Herod., ii. 99), says the reviewer, "Menes (that is one of the earliest kings of Egypt), when he founded Memphis, is related to have diverted the course of the Nile eastwards, by a dam about 100 stadia, about twelve miles south of the city, and must have dried up the old bed. If so, many years must have elapsed before the old bed became filled up by the annual deposits of the inundation, and a piece of pottery may have been dropped into it long after the time of this early king, for we do not know the course of the old bed, and the statue may stand upon it, or the piece of pottery may have fallen into one of the fissures into which the dry land is rent in summer, and which are so deep that many of them cannot be fathomed even by a palm-branch. Or at the spot where the statue stood there may have been formerly one of the innumerable wells or pits from which water was raised by means of earthen pots. Again, we know from the testimony of Makrîosî that less than a thousand years ago

the Nile flowed close by the present western limits of Cairo, from which it is now separated by a plain extending to the width of more than a mile. In this plain one might now dig to the depth of twenty feet or more, and then find plenty of fragments of pottery and other remains less than 1,000 years old! Natural changes in the course of the Nile similar to that which we have here mentioned, and some of them doubtless much greater, have taken place in almost every part of its passage through Egypt.

"Thus far we have adapted our remarks to Mr. Horner's estimate of the mean rate of the increase of the alluvial soil. Most of this estimate is founded upon a grave mistake, that is, upon the assumption that the upper surface of the platform on which the colossal statue stood was scarcely higher than the general surface of the plain. The temple which contained the colossal statue was one of the buildings of Memphis, and, according to Mr. Horner's assumption, it is a necessary consequence that both the city and the temple must have been for many days in every year to the depth of some feet under the surface of the inundation. This is quite incredible, and we may therefore feel certain that the Nile deposit did not begin to accumulate at the base of the statue till Memphis had fallen into ruins, about the fifth century of our era.

"These considerations, and many others which we might urge, tend to show that Mr. Horner's pottery is no more likely than M. Bunsen's chronology to compel us to abandon our faith in the old Hebrew records. But one fact, mentioned by Mr. Horner himself, settles the question. He tells us that fragments of '*burnt brick* and of pottery have been found at even greater depths (than thirty-nine feet) in localities near the banks of the river,' and that in the boring at Sigiul 'fragments of *burnt brick* and pottery were found in the sediment brought up from between the fortieth and fiftieth foot from the surface.' Now, if a coin of Trajan or Diocletian had been discovered in these spots, even Mr. Horner would have been obliged to admit that he had made a fatal mistake in his conclusions; but a piece of *burnt brick* found beneath the soil tells the same tale that a Roman coin would tell under the same circumstances. Mr. Horner and M. Bunsen have, we believe, never been in Egypt, and we therefore take the liberty to inform them that there is not a single known structure of burnt brick from one end of Egypt to the other earlier than the period of the Roman dominion. These fragments of burnt brick, therefore, have been deposited after the Christian era, and, instead of establishing the existence of man in Egypt more than 13,000 years, supply a convincing proof of the worthlessness of Mr. Horner's theory."

This criticism on Mr. Horner Sir Charles Lyell seeks to answer, in his *Antiquity of Man*, by stating that Hekekyan Bey was too sagacious to be deceived by his workmen; that, as most of the borings were made far from the sites of towns and villages, there was but small chance of the borings striking upon the sites of old wells; that there was an equal im-

probability of their striking upon wells used for the purposes of irrigation; and, lastly, in answer to the statement that no bricks were burnt in the valley of the Nile, he quotes Mr. Birch as stating that he has under his charge, in the British Museum, two bricks, one a small rectangular baked brick, which came from a Theban tomb, the style of art, inscription, and date proving it to be as old as the eighteenth dynasty (about 1450 B.C.); secondly, another brick once forming part of an arch, having an inscription, partly obliterated, which he refers, conjecturally, to the nineteenth dynasty, or 1300 B.C.

Now, in answer to this, Sir Gardiner Wilkinson, one of the highest authorities on all matters relating to ancient Egypt, has urged (in reply to the observation) that the bricks and pottery being found in so many pits far from towns presents no difficulty, because of old, as well as now, wells were sunk at places far distant from towns and villages, even on the slope of the sandy desert, for the purposes of irrigation. Their distance from town, and the number of the wells, may be accounted for. Some were sunk, especially those near the desert, for watering the flocks, and for domestic purposes, the water being very frequently carried in jars to a great distance, and occasionally used for irrigation also.

To this I would venture to add the remark, that the borings and shafts were confessedly made on the site of an ancient town, which must have had a large population. Again, with respect to the two bricks in the British Museum, the same eminent authority denies that they are bricks which were ever used for the purposes of building. That the second spoken of never formed part of an arch. That they are burnt clay he admits. Their assumed date he does not dispute, but he states that they were never used for building purposes, and, like many other ancient Egyptian relics made of burnt clay, they do not at all invalidate the argument that no bricks were burnt for building purposes anterior to the Roman occupation of Egypt.

What, however, is still more to the point, this eminent authority, Sir Gardiner Wilkinson, has seen all the fragments upon which Mr. Horner has built his theory, and he states emphatically that he cannot attribute a high antiquity to any one of these fragments. The antiquity of several can be fixed. In page 59 of Mr. Horner's paper a list of objects found in the first shaft and deepest boring at the statue of Rameses II. is given. The fragment of a jar found at the depth of eleven feet has a stamped ornament on it, of the honeysuckle pattern, proving it to be of Greek workmanship, to which no higher antiquity than 200 years B.C. can be assigned. The glass mosaic from the depth of twelve feet is of late, probably

Roman, time. The blade of a copper knife, thirteen feet, is not of great age, and the small vase of white pottery, from a depth of fourteen feet, is of late, apparently of the Greek, period.

Most of the "objects of art" found near the statue of Memphis he decidedly pronounces to be of late time. To a head cut in greyish stone, brought up from a depth of forty feet at Memphis, he assigns no higher a date than the Ptolemaic period. In fact, he states that he saw no signs of any great age in any single fragment, while many were most decidedly of a late period, Ptolemaic or Roman.

In this way the strictures of the *Quarterly* reviewer as to the worthlessness of Mr. Horner's solution of the problem of man's antiquity are fully borne out. Indeed, Sir Charles Lyell himself seems convinced of it; for he neither gives Mr. Horner's rate of the secular increase of Nile mud at 3½ inches per century, nor does he give his assumed antiquity of man at 13,371 years. He also admits the fallacy of Mr. Horner's method of determining the secular rate of the accumulation of the Nile mud.

"The ancient Egyptians" (says Sir C. Lyell) "are known to have been in the habit of enclosing with embankments the areas on which they erected temples, statues, and obelisks, so as to exclude the waters of the Nile; and the point of time to be ascertained in every case where we find a monument buried to a certain depth in mud, as at Memphis and Heliopolis, is the era when the city fell into such decay that the ancient embankments were neglected and the river allowed to inundate the site of the temple, obelisk, or statue. Even if we knew the date of the abandonment of such embankments, the enclosed areas would not afford a favourable opportunity for ascertaining the average rate of deposit in the alluvial plain, for Herodotus tells us that in his time those spots from which the Nile waters had been shut out for centuries appeared sunk, and could be looked down into from the surrounding grounds, which had been raised by the gradual accumulation over them of sediment annually thrown down. If the waters at length should break into such depressions, they must at first carry with them into the enclosure much mud washed from the deep surrounding banks, so that a greater quantity would be deposited in a few years than perhaps in as many centuries on the great plain outside the depressed area, where no disturbing causes intervened."

It is curious that while Sir C. Lyell gives neither Mr. Horner's secular rate of increase of the Nile mud nor the antiquity which he assigns to his fragments of brick and pottery, he gives M. Girard's rate of increase of 5 inches per century between Assouan and Cairo, although he states that Mr. Horner believes this determination to be founded on vague

and insufficient data; but adds, "Were we to assume 6 inches in a century, the burnt brick met with at a depth of 60 feet would be 12,000 years old."

Again, quoting from Mr. Horner's paper the statement of Linant Bey finding a fragment of red brick in the Rosetta branch of the Nile in the parallel of the Delta at a depth of 72 feet, then taking M. Rosière's mean rate of deposit in the Delta at 2·4 inches per century, and estimating this at 2½ inches, he says that this work of art must have been buried more than 30,000 years ago. To a superficial reader, Sir C. Lyell would seem to adopt these two dates of 12,000 and 30,000 years, because they are the only dates he gives in his account of the Nile deposit. Yet a careful perusal shows how carefully he guards himself, so that while an impression may be formed by the hasty reader that Sir Charles accepts these dates, he leaves us in doubt whether he agrees with Mr. Horner in rejecting them. But, if rejected, he must be taken as admitting that nothing whatever with regard to the antiquity of the human race has been determined by the Nile deposits.

If, however, the results of Mr. Horner's experiments go to prove anything at all, they give a much higher rate of annual increase of the Nile mud than has hitherto been assigned. If a work of Greek art not more than 2,000 years old has been brought up from a depth of 40 feet, this would give a rate of increase of 2 feet per century. This seems to be confirmed by a fact stated by Sir Gardiner Wilkinson. He has seen pieces of the alluvial deposit left on a rock and dried in the sun after one inundation. Such pieces assume a concave form almost like a piece of pottery, and are three-eighths of an inch in thickness; this, too, taken from rock at the extreme range of the inundation at Thebes, where it would be much thinner than on the plain, where the deposit would be greater. This would give 3 feet per century as the mean rate of deposit, an inference incidentally confirmed by a passage in Mr. Horner's paper, where he states, p. 68, "As a proof of the more rapid deposition of the heavier particles, even so low down as Cairo, I may mention, that at the ebb of the river after the inundation of 1853, it was found that the deposit on the Mastaba or landing-place of the Rhoda Nilometer, that is, at the 9th cubic mark on the column, was 6 inches in thickness; on the 4th step above it about 2¼ inches; and on the 16th step not more than 1¼, each step being rather more than 9 inches deep." Now, bearing in mind that Cairo is ten miles nearer the mouth of the sea than Memphis, three-eighths of an inch cannot be taken as an extravagant estimate for the annual deposit.

You will remember that when Professor Huxley preached us his lay sermon on Genesis xli. 38, 39, he stated dogmatically that the rate of the Nile deposit was one foot per century, and seeing that the Nile mud was in some places more than 70 feet deep, this would give us 7,000 years as the minimum period during which the Nile deposit above the delta has been accumulating. Now I maintain that we have good scientific reasons for dividing this sum by 3, or at any rate by 2. For I have as good grounds for asserting that the rate of accumulation is 2 or 3 feet per century as Professor Huxley has for assuming it to be 1 foot. Taking the smaller estimate, 3,500 years, even taking Ussher's chronology for the flood, gives me a good margin to allow for a few feet below the 70. Though I must remark, that at 40 feet, the boring near the statue of Rameses II. at Memphis passed through the alluvial deposit and entered the sand.

Could I not give such data as I have done for assuming the mean rate of deposit as much greater than one foot per century, I cannot see that Professor Huxley's sermon would gain much force. Supposing it could be proved, although I maintain that it has not been proved, that during the last 2,000 years the rate of increase has been no more than one foot per century, we are by no means able to assume that this has always been its mean rate. The Nile is subject to floods. In September, 1818, Belzoni witnessed one, where, although the river rose only 3½ feet above its ordinary level, several villages, with hundreds of men, women, and children, were swept away by it. Professor Huxley reminded us that the ground through which the Nile now flows was once under the sea. The whole region through which the Nile runs must therefore have been elevated to its present height. Who, therefore, can venture to estimate the rate at which the newly-formed river would deposit mud in its course? Who can estimate the number of lakes in the highlands of Africa (from whence the Nile takes its rise)? Who can estimate how many of these lakes may have burst their bounds and poured at once a vast body of turbid water into the river? Only a few years ago a comparatively paltry body of water, dammed up as an artificial reservoir, near Sheffield, burst its banks, and in a few minutes carried havoc and destruction through a peaceful valley, uprooting trees, demolishing houses, and tossing about the heaviest iron tilt-hammers and machinery like chips of wood. A few minutes served to fill the lower stories of houses miles from the reservoir, and even at a good distance from the river bed, with a deposit of more than a foot of mud. Sir Charles Lyell has given a vivid descrip-

tion of the bursting of a lake in his *Principles of Geology*. The upper portion of the valley of Bagnes was converted into a temporary lake by the damming up of a narrow pass by avalanches of snow and ice, precipitated from an elevated glacier into the bed of the Dranse. The lake was half a league in length, 700 feet wide, and 200 feet deep in some places. Half the contents of this lake were quietly drained off by an artificial channel,*

"But at length, on the approach of the hot season, the central portion of the remaining mass of ice gave way with a tremendous crash, and the residue of the lake was emptied in half an hour. In the course of its descent, the waters encountered several narrow gorges, and at each of these they rose to a great height, and then burst with new violence into the next basin, sweeping along rocks, forests, houses, bridges, and cultivated land. For the greater part of its course the flood resembled a moving mass of rock and mud, rather than of water. Some fragments of granitic rocks of enormous magnitude, and which from their dimensions might be compared, without exaggeration, to houses, were torn out of a more ancient alluvion, and borne down for a quarter of a mile. One of the fragments moved was sixty paces in circumference. The velocity of the water, in the first part of its course, was thirty-three feet per second, which diminished to six feet before it reached the Lake of Geneva, where it arrived in six hours and a half, the distance being forty-five miles.

"This flood left behind it, on the plain of Martigny, thousands of trees torn up by the roots, together with the ruins of buildings. Some of the houses in that town were filled with mud up to the second story. After expanding in the plain of Martigny, it entered the Rhone, and did no further damage.

"Now," continues Sir C. Lyell, "if part of the lake had not been gradually drained off, the flood would have been nearly double, approaching in volume to some of the largest rivers in Europe. It is evident, therefore, that when we are speculating on the excavating force which a river may have exerted in any particular valley, the most important question is, not the volume of the existing stream, nor the present levels of its channel, nor even the nature of the rocks, but the probability of a succession of floods at some period since the time when the valley may have been first elevated above the sea.

"For several months after the débâcle of 1818, the Dranse, having no settled channel, shifted its position continually from one side to the other of the valley, carrying away newly-erected bridges, undermining houses, and continuing to be charged with as large a quantity of earthy matter as the fluid could hold in suspension."

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* Lyell's *Principles of Geology*, vol. i. p. 364, 6th edition.

After this caution on the part of Sir Charles Lyell, one which he so strangely neglects himself, we cannot be deemed unscientific or unduly instructed if we refuse to admit that any scientific proof has been given that the Nile valley is any older than the most recent period assigned to the Noachian Deluge.

With regard to Sir Charles Lyell's assumed age of 100,000 years as the minimum time in which the Mississippi delta has taken to accumulate, and Dr. Dowler's estimate of 50,000 years for the antiquity of the skeleton found sixteen feet deep in Mississippi mud, I cannot do better than quote from Professor Kirk's admirable little work, *The Age of Man Geologically considered in its Bearing on the Truths of the Bible.* [London: 1866.]

"The most important of all the accumulations of mud to which attention has been called in connection with the age of man upon the earth, is that formed by the Mississippi. The delta of this great river covers an area of many thousand square miles. It has required, according to an estimate of Sir Charles Lyell, above 100,000 years for its formation. If we assume that the delta in question is on an average of 200 feet deep, this estimate will call for 500 years as the time for adding a single foot to its surface! only the one-fifth part of a foot, less than two inches and a half, in a century! less than the fiftieth part of an inch in a year! The reader will observe how the power of fancy grows in this wild logic.

"First, the thirty-second part of an inch in a year—then the fortieth part—now the fiftieth part! Can any man in his senses soberly look at this as matter of fact and worthy of being associated with the name of science? Yet we shall see that all-important conclusions are derived from it. In one part of this delta, at a depth of sixteen feet from the surface, 'beneath four buried forests, Dr. Dowler found some charcoal and a human skeleton.' The worthy Doctor ascribes to this man, whose skeleton was thus found, an antiquity of 50,000 years! Sir Charles Lyell says that he 'cannot form an opinion as to the value of the chronological calculations' by which this result is gained. We think he might be able to form a very strong opinion on the subject if he were earnestly disposed. First of all to take the growth of the mud—50,000 years for sixteen feet! This beats Sir Charles with his 100,000 years for the several hundreds of feet in the whole delta, and beats him hollow. But then there are 'four forests,' only these are packed in less than sixteen feet of space, for we must allow something to have lain above the uppermost of the four. If these 'forests' grew on the spot we must have soil for each to grow in, as well as space in which it could lie, and all this in less than sixteen feet! Yet we must give 50,000 years to this miniature formation in geology. A stream capable of burying forests so as to pack four of them in less than sixteen feet of vertical space when forming its delta, is to be, nevertheless, allowed not less than five centuries to lay down twelve

inches of mud on the surface! And we are to regard all this as sober science, destined to lead us to greatly 'advanced religious views,' and as far beyond the teachings of Moses as the 'educated classes' could wish to be ahead of the common multitude! We have had to read Sir Charles's statements over and over many times in order to believe our own eyes that he had really published to the world such monstrous examples of speculation. And yet such is the fact; with the solemn gravity of a high priest of science he spreads out his marvellous cogitations, and satisfies, too, the credulous souls, who will trust anything rather than the Bible, that man has been on the earth for hundreds of thousands of years!

"Let us just take one fact adduced by Sir Charles Lyell himself, and one which is pregnant with force against these reckless speculations. Speaking of a fossil bone which was found near Natchez, he says:—'Owing to the destructible nature of the yellow loam, every streamlet flowing over the platform has cut for itself, in its way to the Mississippi, a deep gully or ravine.' He mentions one of these ravines which is seven miles long, and in some places sixty feet deep, which had no existence before 1812. There was an earthquake at that date which shook the land all about Natchez, and so far accounted for some of those fissures that had been cut so deeply; but Sir Charles saw when he was there that the streams were widening and deepening all their channels, and consequently carrying immense quantities of mud into the river, which was in its turn bearing it on to its delta in the Gulf of Mexico. Yet he could coolly calculate that all this would allow of only something less than the fiftieth part of an inch of sediment laid on the surface of that delta in an average year!"

If any one wished for an exemplification how one part of the writings of Sir Charles Lyell may be brought to contradict another, and how his facts controvert his theories, I would refer him to this masterly little book of Professor Kirk's which I have just quoted.

I cannot pass from my present subject of the great antiquity assumed for Egyptian civilization without referring to an instance in which that antiquity was sought to be proved on the strict scientific grounds of astronomical demonstration, and how it melted away before an accurate investigation. On the ceiling of the portico, and also on the ceiling of one of the apartments of the large temple at Denderah, in Upper Egypt, the best preserved and one of the most splendid of Egyptian ruins, the French *savants* supposed that they recognized the signs of the Zodiac.

"Dupuy and other French writers assumed from the relative position of those Zodiacal signs, and their connection with the precession of the equinoxes, that the astronomical observations upon which these Zodiacs were constructed, must refer to a date far more ancient than that recorded for the

Deluge, or even the creation of man; not less, indeed, than 15,000 years, according to some."

Yet an accurate investigation has proved that these assumed Zodiacs are no Zodiacs at all; that the temple itself bears inscriptions proving incontestably that it is not older than the first century of the Christian era.

I shall now proceed to consider some of the difficulties which have been urged from the science of geology, to the inspiration of the writings of Moses. These difficulties have not arisen from the facts of geology, but from the hasty interpretation of the facts; from theories and hypotheses, ever changing, and all seemingly doomed to very short duration. I know no science in which the precepts of Bacon have been more neglected, in which the philosophy of the sound inductive method has been more disregarded. The injury done to science by hasty generalizations and theories founded on insufficient data are best stated in Bacon's own words.

"Another error" (says Lord Bacon, in his *Advancement of Learning*), "of a diverse nature from all the former, is the over-early and peremptory reduction of knowledge into arts and methods, from which time commonly sciences receive small or no augmentation. But as young men, when they knit and shape perfectly, do seldom grow to a further stature, so knowledge, while it is in aphorisms and observations, is in growth; but when it once is comprehended in exact methods, it may perchance be further polished and illustrated, and accommodated for use and practice, but it increaseth no more in bulk and substance. Another error hath proceeded from too great a reverence and a kind of adoration of the mind and understanding of man, by means whereof men have withdrawn themselves too much from the contemplation of nature, and the observations of experience, and have tumbled up and down in their own reason and conceits. Upon these intellectualists, which are notwithstanding commonly taken for the most sublime and divine philosophers, Heraclitus gave a just censure, saying, 'Men sought truth in their own little worlds, and not in the great and common world,' for they disdain to spell, and so by degrees to read, in the volume of God's works; and contrariwise, by continual meditation and agitation of wit, do urge and as it were invocate their own spirits to divine and give oracles unto them, whereby they are deservedly deluded."

I shall endeavour to make good my assertion regarding the science and progress of geology.

One great fact is admitted by all geologists, that there is no part of the now dry land which did not once lie below the sea. This fact fully bears out the words of Moses, "And the earth was without form and void, and darkness was upon the face of

the deep, and the spirit of God moved upon the face of the waters." (Gen. i. 2.) "And God said, Let the waters under the heaven be gathered together into one place, and let the dry land appear, and it was so." (Gen. i. 8.)

Until recently the generally received geological theory has been this:—The lowest parts or foundations of the earth consist of unstratified rocks, called plutonic, all of igneous formation. Above these lie the metamorphic, or stratified crystalline rocks, containing, like the former, no trace of organic life. These are assumed to have had an aqueous formation, but to have become crystalline and lost all traces of organic structures by the action of heat. Above these, the strata, all sedimentary in character, are divided into three great divisions —primary, secondary, and tertiary. Each of these again into numerous subdivisions. These strata lie over one another always in the same order, though they are frequently raised from the horizontal position to every angle up to the perpendicular. Many of these strata are often altogether wanting. Any one may form the surface of a country, and frequently the plutonic rocks themselves are quite bare and destitute of any overlying strata. The strata are not distinguished from one another by any certain mineralogical or lithological characteristics, their age and position being determined by the organic remains they contain. To their gradual formation millions of ages have been assigned. Until very recently (except by a few geological heretics) they were supposed to indicate as many successive creations as they contained distinct fauna, man and the present vegetable and animal inhabitants of the world not making their appearance in the geological records till the post-tertiary period.

To account for the varied appearances, contortions, inversions, and breaks in these fossiliferous strata, the now dry land, was at one time supposed to have been at the bottom of the sea; then to have been raised above the waves; its coasts worn away by the sea, and its hills denuded by rainfalls; then depressed again below the ocean for many fathoms; this process repeated again and again; the temperature at one time that of the torrid zone, and another of the arctic regions; most places at one time lying under an ocean teeming with melting icebergs, or else overlaid by vast glaciers. This may be called the successive creation theory. It met for a long time with almost universal acceptation. It presented little or no difficulty to the theologian; as Dr. Buckland's interpretation of the first chapter of Genesis was supposed to reconcile all difficulties. All these changes took place in that vast period which, on the authority of great Hebrew scholars (maintained

long before geology was dreamt of), was held to lie between the first verse of Genesis—"In the beginning God created the heavens and the earth," and the second verse, "And the earth was without form and void, and darkness was upon the face of the deep,"—the six days of the Mosaic creation having only reference to man's appearance on the earth, together with the existing fauna of animate life. Has this successive creation theory been founded on insufficient data — on hasty generalization combined with too little acquaintance with the fossiliferous remains of the earth's strata, and the creatures at present inhabiting the globe? Sir Charles Lyell answers this question in the affirmative in his recent editions of the *Elements of Geology*. I know of no instance in which this theory has tended to the progress of geological knowledge. Sir Charles Lyell admits that it has had a retarding effect. During the whole time this theory has been fashionable, facts have been burked and pooh-poohed. No geologist of eminence, no scientific man of known reputation, held any other, was the answer to every heretic who adduced any awkward facts in contradiction. Take, for instance, the association of man with the extinct gigantic mammalia.

"The stories," remarks Sir Charles Lyell (*Antiquity of Man*, p. 34), "widely circulated of the bones of the mastodon having been observed with their surfaces pierced as if by arrow-heads, or bearing marks of wounds, inflicted by some stone implement, must in future be more carefully inquired into, for we can scarcely doubt that the mastodon in North America lived down to a period when the mammoth co-existed with man in Europe." *Antiquity of Man*, p. 95:—"A correct account of the associated flint tools, and of their position, was given in 1847 by M. Boucher de Perthes in his work above cited, and they were stated to occur at various depths, often twenty or thirty feet from the surface, in sand and gravel, especially in those strata which were nearly in contact with the subjacent white chalk. But the scientific world had no faith in the statement that works of art, however rude, had been met with in beds of such antiquity." *Antiquity of Man*, p. 104:—"After a lively discussion on the subject in England and France, it was remembered not only that there were numerous recorded cases leading to similar conclusions in regard to cavern deposits, but also that Mr. Frere had, so long ago as 1797, found flint weapons of the same type as those of Amiens in a fresh-water formation in Suffolk, in conjunction with elephant remains, and nearly a hundred years earlier (1715) another tool of the same kind had been exhumed from the gravel of London, together with the bones of an elephant."

Speaking of the human bone accompanying bones of the

mastodon found at Natchez, on the Mississippi, Sir Charles Lyell (*Antiquity of Man*, p. 200) makes this candid admission :—

"After visiting the spot in 1846, I described the geological position of the bones, and discussed their probable age, with a stronger bias, I must confess, as to the antecedent improbability of the contemporaneous entombment of man and the mastodons than any geologist would now be justified in entertaining."

Sir Charles Lyell, in the 27th chapter of his *Elements*, 1865, has shown how progressive has been the march of discovery in finding relics of supposed more recent creations among those of the older. I cannot detain you by quoting as fully as I could wish. I will confine myself to one extract only :—

"There are many writers still living who, before the year 1854, generalized fearlessly on the non-existence of reptiles in times antecedent to the permian ; yet in the course of nineteen years they have lived to see the remains of reptiles of more than one family exhumed from various parts of the carboniferous series. Before the year 1818, it was the popular belief that the palæotherium of the Paris gypsum and its associates were the first warm-blooded quadrupeds that ever trod the surface of this planet. So fixed was this idea in the mind of the majority of naturalists, that when at length the Stonesfield mammalia were brought to light, they were most unwilling to renounce their creed. First the antiquity of the rock was called in question, and then the mammalian character of the relics."

The successive creation theory is thus acknowledged again and again by Sir Charles Lyell to have been always obstructive, never helpful, to the progress of geology.

But it has not only been crumbling before facts linking together the supposed successive strata, by carrying down the higher forms of life to lower strata; below the tertiary nearly all strata are more or less pelagic in their origin. The medals of creation most abundant, and determining their specific character, are the shells and other creatures of marine origin. The progress of discovery has been equally steady in discovering among existing species those thought to be long extinct. No species of the terebratulæ were supposed to exist till the late Captain Ince dredged some up from the harbour of Port Jackson, and only last summer twenty specimens of terebratulæ were found off the island of Skye, showing the wide distribution in our present seas of a creature supposed to be extinct.

Every geologist must admit how imperfectly the geological records available to man's inspection have yet been read. Every naturalist will tell you how little really we know of the denizens of the sea. Who can tell what marine saurians may

still sport themselves among the meadow-like verdure of the vast Sargasso seas?—the Atlantic, one little less in area than the surface of Europe, teeming with vegetable life, being, for the most part, green as any meadow, and covering the ocean as with an emerald mantle, where sea-weeds float with stems 800 feet long. The progress of geological discovery is breaking down, and rendering the successive creation theory no longer tenable. Yet with all this progress we find no traces of successive development. Mr. Darwin can find no proof of his favourite theory in any known geological records of the earth's history. He confesses that he can only expect to find his negative evidence in strata hereafter to be explored far beneath any strata yet investigated. Sir Charles Lyell would seek for the same negative evidence of the ape's transformation into man in unknown geological strata!

But what can be more unphilosophical than theories which depend, not on facts, but on negative evidence—that is, simply on the dreams of man's imaginative faculty? The actual progress of geology leads us only to the unity of the creation. It gives no countenance to any progressive development. The lowest forms of the supposed most ancient strata have not made the slightest progress. Their congeners—nay, in many instances the same identical species—swarm in our existing seas without showing the slightest trace of modification or progress. The foraminifera, dredged from the bottom of the Atlantic, and now flourishing abundantly on the surface of the Atlantic, are specifically identical with those whose fossils are so abundant in the cretaceous formation of Europe. Sir Charles Lyell says, in his *Elements*, p. 318:—

"That white chalk is now forming in the depths of the ocean may now be regarded as an ascertained fact, because the Globigerina bulloides is specifically undistinguishable from a fossil which constitutes a large portion of the chalk of Europe."

But what, I would ask, must fall with the successive creation theory? If all geological strata contain only the records of one creation—if there be no proof, but rather the contrary, of any new creation, of the successive appearance of any new species, the originals of the present earth's fauna must be as old as any creatures whose remains can be found in the marine-formed strata of the earth. The fossil medals of creation must, with the fall of the successive creation theory, fail to give any record of the time when they were stamped in Nature's mint—at any rate, till some sure evidence be found on which the development theory can rest.

But then I shall be reminded that the upheaval of our present land, and the depths of the strata filled with marine fossils, must have taken an incalculably lengthened period of time. To which I reply that science can give no proof of this lengthened period.

Sir Charles Lyell states 2½ feet per century as his normal period for the elevation of land above the sea.

Sir Charles states (*Antiquity of Man*, p. 58):—

"The upward movement now in progress in parts of Norway and Sweden extends, as I have elsewhere shown, throughout an area about 1,000 miles N. and S., and for an unknown distance E. and W., the amount of elevation always increasing as we proceed towards the North Cape, where it is said to equal 5 feet in a century. If we could assume that there had been everywhere an average rise of 2½ feet in each 100 years for the last 50 centuries, this would give an elevation of 125 feet in that period." "A mean rate of continuous vertical elevation of 2½ feet in a century would, I conceive, be a high average; yet even if this be assumed, it would require 24,000 years for parts of the sea-coast of Norway, where the post-tertiary marine strata occur, to attain the height of 600 feet."

This unit measure of 2½ feet per century elevation is that which Sir Charles Lyell uses everywhere throughout his *Antiquity of Man*, to estimate the period land has taken to be elevated. But this unit is purely theoretical and conjectural, having, in all probability, as much foundation in fact as the 2½ inches of increase in Nile mud per century. Let us test the theory by fact, Sir Charles himself being the witness cross-examined.

Speaking of the rise of 1,000 miles of the coast of Chili after the earthquake of 1822, he says (*Principles*, vol. ii. p. 304):—

"By some observers it has been supposed that the whole country from the foot of the Andes to a great distance under the sea, was upraised in 1822, the greatest rise being at the distance of about two miles from the shore. 'The rise upon the coast was from 2 to 4 feet; at the distance of a mile inland it must have been from 5 to 6 or 7 feet.' It has also been conjectured by the same eye-witnesses to the convulsion, that the area over which this permanent alteration of level extended may have been equal to 100,000 square miles."

Prodigious! Theory, 2½ feet per century. Experience of eye-witnesses, twice that on the coast, and a mile inland more than three times that amount, in a few hours of time. Again, let us take the evidence of eye-witnesses of the effects of the earthquake of 1835 on the same coast. I quote from Mr. Darwin's *Journal*, p. 310:—

"The most remarkable effect of this earthquake was the permanent eleva-

tion of the land. There can be no doubt that the land round the Bay of Concepçion was upraised 2 or 3 feet; at the island of St. Maria (about 30 miles distant) the elevation was greater; on one part Captain Fitzroy found beds of putrid mussel-shells still adhering to the rocks 10 feet above high-water mark, where the inhabitants had formerly dived at low water spring-tides for these shells."

After this testimony of "experience" *versus* "theory," a man must be a bold one who would take any upheaval theory as a basis for a chronometrical scale of geological ages.

Again, we have the vast depths of certain strata, the chalk, for instance, formed for the most part of the skeletons of minute infusoria, foraminifera, diatomaceæ, and other creatures. These, we are told, must have taken myriads of ages to form. Ehrenberg estimates that there are 41,000 millions of the silicious skeletons of diatomaceæ in one cubic inch of Bilin tripoli. That gives a little cube, each of its sides being the ten-thousandth part of an inch in size, for each of these remains. Some say the chalk foraminifera are smaller than these diatomaceæ. Let us take their little cubes as one hundred-thousandth part of an inch, then we shall have 10^{15}, that is, 1 followed by 15 ciphers, for the number packed in a cubical inch of chalk formed solely of their remains. Surely the cretaceous strata of Europe, formed by such minute creatures, must have taken myriads of ages in its formation. Let us test this by a little arithmetic. We will suppose one foraminifera created, in one year to produce 10 others, each of these 10 more the next year, each of these 10 the next year, and so on, multiplying tenfold each year; at the end of any given year the number produced will be 10^{n-1}, ^{n} being the number of the years elapsed.

The number of cubical inches in a cubic mile lies between 10^{14} and 10^{15}. Taking the larger of these two figures for convenience in calculation, 10^{15} multiplied by 10^{15}, equalling 10^{30}, will give the number of foraminifera in a cubic mile. Multiplying this number by 10^{16}, we shall have 10^{46} for the number of foraminifera covering an area of 100 million of square miles a mile in height. Hence, the foraminifera produced in the 47^{th} year alone would cover more than an area of 100 million of square miles a mile high. Less than half a century. Now, if I had taken days instead of years for the probable average duration in which the generations of foraminifera multiply, and if I had taken their increase as a hundredfold instead of tenfold, I might not probably have erred from the facts of nature. But it will be objected that long before such a rate could be reached, food for the nourishment of the foraminifera

would fail. Granted. What then? The possible increase of the foraminifera is only practically diminished by their supply of food failing, and the rate in which their enemies devour them. Any way, hundreds instead of myriads of years is all that arithmetical computation can afford us as a clue by which to estimate the time the cretaceous formation of Europe might probably take to form.

Practically, we know too little about what is now forming in the depths of the Atlantic and Pacific oceans, miles below the surface, to have any conception of the changes that may take place in the depths of the sea. We cannot guess the rate at which strata may accumulate. What would a man know of the surface of the earth if he had been all his life sailing in a balloon, and never approaching that surface nearer than two or three miles? Suppose his knowledge of this surface was derived from a few quillfuls of earth drawn up from it. This is no exaggerated account of all we know of deep-sea bottoms. We know that vast currents run, not only on the surface of the sea, but circulate through its depths. We know not the power of subaqueous storms in these currents. We know not how they may lift sedimentary deposits from one part of the ocean-bed and lay them over other strata. We know not how these currents may pile strata after strata of material round the rugged sides of submarine mountains at all kinds of inclinations. Knowing this vast depth of human ignorance, surely this should be a reason why we should display profound humility while we learn to spell and by degrees to read in the volume of God's works—why we should not substitute for this discipline a false worship and adoration of the mind and understanding of man.

The shafts of ridicule have been urged against those well-meaning men who have from time to time endeavoured to make the writings of Moses square with the fashionable theories of geologists. But why have they failed? Because they have been too credulous in accepting unproved hypotheses as scientific verities.

But now, when the incandescent state of the earth, passing through all stages from a flaming vapour to crystallizing granite, with indefinite ages for the cooling process, is ruthlessly committed to the limbo of exploded hypotheses; when the Huttonian theory of the igneous formation of granitic and other kindred rocks gives place once more to the water formation of Werner; when the successive creation theory, with all its power of determining age of strata by their palæontological remains, seems melting before the inexorable logic of facts; while the Darwinian or rather Lamackian theory of progres-

sive development can claim no solid foundation in nature to rest on, but only the assumed force of negative, that is, imaginary evidence; the believer in revelation may well pause when asked to make revelation square with theoretical geology. He can wish the investigator of geological facts God-speed while he investigates the relics of the past, and wait patiently the collection and digestion of such a body of facts as may render speculation less hazardous than it has hitherto been, in attempting to construct the history of the past from the records it has left in the earth's strata.

[When this Paper was read in Sion College, there was introduced at this place an argument in favour of the evidences of design to be observed in nature, which was omitted in reading the Paper in the Victoria Institute, as the omitted passages had been previously delivered in the Institute, in Mr. Mitchell's Inaugural Address.—*Vide* vol. i. of the *Journal of Transactions*, pp. 54 to 68.]

The assertion "that the gradual reduction of all phenomena within the sphere of established law carries with it as a consequence the rejection of the miraculous" (upon which assertion modern rationalism has invaded the domain of theology and natural philosophy), has only to be brought face to face with the highest inductions of modern science to meet its own refutation. We are not required to banish God, to banish a Creator from the physical world, to cultivate with freedom the revelations of modern science. The assumed laws which replace design by rigid fate crumble before a calm dispassionate investigation. As men of science we can believe not only that God created us; but we can confess, with heathen poets of old, that "we are His offspring," seeing that "in Him we live and move and have our being." That no disbelief in the miraculous, no knowledge of correlation of forces, no conservation of *vis vitæ*, compels us to deny that "He left not Himself without witness in that He did good, and gave us rain from heaven, filling our hearts with food and gladness." Our philosophy still allows us with simple hearts to pray "Give us this day our daily bread." We can still believe that no sparrow can fall to the ground without our heavenly Father's knowledge and will. Nay, the more we know, the more deeply we investigate the phenomena of nature, the more are we compelled to admit our own ignorance. "Hardly do we guess aright at things that are upon earth, and with labour do we find the things that are before us." Laws of nature, we confess with Hooker, have in them "more than men have as yet attained to know, or perhaps ever shall attain, seeing the travail of wading herein is given of God to the sons of men,

that perceiving how much the least thing in the world hath in it more than the wisest are able to reach unto, they might by this means learn with humility." Humbly we confess with Bishop Butler, "other orders of creatures may perhaps be let into the secret counsels of Heaven, and have the designs and methods of Providence in the creation and government of the world communicated to them, but this does not belong to our rank and condition."

The CHAIRMAN.—You will allow me to thank Mr. Mitchell for his very able paper. It is another of the valuable contributions that he has made, not only in support of revealed truth, but in support of science; indeed, it is more eminently in support of science than of revealed truth. I now invite discussion upon the paper, for which we all thank Mr. Mitchell heartily. (Applause.)

R. BAXTER, Esq.—I should like to mention a fact or two that relate to the law of deposits. Having had considerable means of observation on the borders of the great tidal river the Trent, I may mention a few circumstances in order to show why we observe the laws of currents and deposits. We have on the borders of that river more than 20,000 acres under the level of the sea, and we take means to let in the tidal waters on this land, in order to make a deposit of the mud carried in the stream, and so improve the land. We do this statedly year by year, and it is a regular trade and profession. A man embanks about 300 or 400 acres, gets the water all about that area, and the principal thing at which he aims is to get the deposit of mud equally distributed. In effecting this work, he cannot help observing the law of deposits. He finds that there is always a certain quantity of deposit, if even the stream is running at the rate of three miles per hour; but according to the strength of the stream so is the quantity of alluvial matter carried. I have seen instances, when the spring tides have been coming up, where the earth has been carried in such large flakes that you might have put your hand in and gathered a great lump of the mud which the stream was carrying away. When the strength of the stream is retarded, then the deposit most rapidly takes place; and when it is let into an embanked area it becomes perfectly still, and the deposit of the substances then takes place. We see in the river Trent islands formed in 20, 30, 40, or 50 years, and in the next 20, 30, 40, or 50 years they are carried away. And why is this? Because the current has changed. In the system that I have described, and called "warping," banks are made here and there to change the current, by which means that which has been deposited is often carried away. How totally unreliable must be any law of deposits by inches or feet in a century, when we remember how, on the principle I have described, one year's flood, if it is higher than usual, will carry away the deposits of previous years, and settle them perhaps lower down the stream, where the river is more quiet, owing to the extended area over which it has to flow! I have seen, among the results of changing and checking currents, where drains, 150 yards long,

30 or 50 yards wide, and 15 feet deep, have been filled up to the extent of six feet in a single year; and you will find frequently six feet of level deposit laid in one of those channels in a single season, and sometimes six inches will be laid in one set of spring tides, which I think are generally reckoned to number three, or four, or five. Seeing, then, that deposits depend on the continuity or interruption of a stream, there can be no law of deposits, especially when the flow of that stream often depends on accidental circumstances. (Hear, hear.) There is another fact supplied by this district which affects the question of coast elevation. This very district of which I have been speaking, extending over about 20,000 acres, has not been elevated, but depressed. It was, in fact, once a forest, and the farmers dig up the trees *in situ*, split them, and carry them into the market towns for kindlings [firewood]. If the sea was to be let in over that area it would cover it to a depth of six or eight feet. How, then, could the forest have grown there at the present level? And we know there have been no artificial embankments to keep the tide out, excepting those which have been very recently made. The country has been depressed, and altered its level; and it is because of that depression that we can carry on the system of warping, and at the end of two years or so improve land worth ten shillings an acre till its value is fifty shillings an acre. There is thus a law of depression as well as a law of elevation, and in studying this question we should remember the operation of those laws. It is only by treating geology in this way—first the fact and then the inference—that you can arrive at anything like reliable results. If we take the inference without the fact we are sure to be wrong, and unquestionably we have of late been doing what is very like that. We have been too rapid in the formation of our theories; we have reduced them to form and moulded a system, and now that facts are breaking in upon us they are completely destroying our system, and we have to begin our learning anew. (Applause.) We ought to be much obliged to Mr. Mitchell for his very able paper; and I trust that we shall have other papers of that kind from time to time.

Mr. BROOKE, C.E.—I have been largely engaged for twenty-four years in the navigation of rivers, and I, too, can speak of the effects of currents upon deposits. A reference was made to the Nile. The International Committee report that in the borings for the Suez Canal marine shells were found of the same kind as those which now exist in the Red Sea. The deposits of the Nile are sometimes spoken of as though they were only deposits of mud; they are vast deposits of sand——

The CHAIRMAN.—Would you be good enough to state whether you are speaking of the bed of the river, or of the Delta?

Mr. BROOKE.—If you wish to consider the deposit higher up above Cairo, you must remember the effect of damming up the stream. The works of recent pashas must of necessity have had their effects upon the deposits both above and below, and we know not but that similar works may have existed in times gone by. I repudiate the notion that we are called upon to believe the theories which Mr. Mitchell has so ably combated.

Mr. WADDY.—I do not for a moment mean to say that we are to suppose the rate of deposit in the Nile can be judged by the rules of deposit as applied to the Trent. To compare the two, you must discover whether the consistency of the deposit is the same in the two streams; and if even you have discovered and settled that point, it does not follow that you have got a law of deposits that will carry you through centuries. There is not the slightest reason for believing that the rate of deposit now is the same that it was a hundred years ago. Your deposit now may be at the rate of a single inch per year, but it does not follow that it was the same 20 or 2,000 years ago. I am told by those who are well able to judge that nothing is more clearly proved than this in warping, that the earlier deposits are a great deal thicker than the later ones, because of the greater depth of water and the greater quantity of mud that would be brought down the stream in its earlier flowings. When the channel is new there is more mud washed down than when it is old; and where there is less water there is less deposit. Supposing the date of the statue to be quite fixed, and the borings to be relied upon, you are no nearer the truth, because, as I have just said, you have not and cannot have a knowledge of the variable rate of the deposit. There is another fact to be borne in mind. The deposit only takes place after the river begins to rise, and then it is not in the channel, but in the calm beyond the banks. Within twenty-four hours after the occurrence of the dam-accident near Sheffield I saw the scene of the catastrophe, and I did not see such a deposit in the bed of the torrent, whereas up the sides of the valley it was six or seven inches thick. The best authority that I can find on this matter tells me that it is utterly impossible to form any notion whatever, or any average, of the deposit of alluvial matter, there are so many contributing and conflicting causes,—the speed of the stream, the depth, and the quantity of mud carried in it. If the stream is higher than usual, it washes away the deposit of former years. I quite coincide with all that has been said of the value of this paper, but I don't quite think Mr. Mitchell should say that Professor Huxley stated dogmatically that the rate of deposit was one foot per century; he believes five inches, but for the sake of argument he says one foot.

Mr. MITCHELL.—Yes; I confess that is so, but I thought it was obvious that I started from the same ground that Professor Huxley adopted.

Mr. WARINGTON.—I should like to make a few remarks on two points, the Nile deposits and chalk. As to the Nile deposits, I would throw out a suggestion by which this question of the average rate of deposit might be settled, independently of borings or measurings. If samples of the water brought down the stream before any deposit takes place were bottled, and other samples were taken during and after the deposit had begun, and these observations were made from year to year, you might get a fair average of the quantity of sediment; the bulk of water and the area over which it flowed might also be discoverable, and you might then get some clue as to how long the Nile deposit has been accumulating. Then as to the chalk. Here I must join issue with Mr. Mitchell entirely, for he has overlooked one

most important element in his problem. He alludes to the food of the foraminifera. Now, part of that food must be of a peculiar character. The shells of these foraminifera which form the chalk are made up of carbonate of lime. That carbonate of lime must have been in solution in the water in order that they might assimilate it and form it into shell. The only form, so far as we know, in which carbonate of lime can be thus assimilated from water, is its solution in carbonic acid. As carbonate of lime dissolved in carbonic acid, then, must all the chalk have first existed in the water before the foraminifera could appropriate it to form their shells. But here we have at once a limit to their multiplication. Directly the carbonate of lime falls off, their growth and increase must fall off too. Now, the quantity of carbonate of lime which water, even when saturated with carbonic acid, is capable of holding in solution is but small. Even supposing the whole sea to be thus saturated, only a thin crust of carbonate of lime would be formed by the removal of the carbonic acid. Nor, if the deposition of the carbonate of lime took place through the agency of foraminifera, would the amount of rock so formed be any greater. The carbonate of lime thus removed, the increase of foraminifera would be altogether stopped, except a fresh supply could be obtained. This supply cannot arise from the solution of fresh carbonate of lime within the sea itself, because if there be free carbonic acid sufficient for this end it would dissolve, not only any limestone that might be there, but also the shells of the dead foraminifera themselves, and thus in another way put a stop to their accumulation. Whence, then, can the supply come? It can come certainly from the rivers, which are constantly bearing down carbonate of lime in solution into the sea. But, then, the supply from this source is very small as compared with the bulk of chalk to be formed. Taking all these points into consideration, it seems to me utterly incredible that the vast masses of chalk now in existence could have been formed in the time, or anything like the time, that Mr. Mitchell is disposed to allow. Had I known that the point was coming up in the paper to-night, I would have gone into the matter more exactly, but as it is, I am of course only able to deal with it roughly and in general terms.

Professor MACDONALD.—Am I to suppose that Mr. Mitchell objects to the successive creation theory?

Mr. MITCHELL.—I have only given what Sir Charles Lyell himself says; I have taken him as my authority, and I agree with him that the whole evidence of modern geology is tending against the successive theory.

Professor MACDONALD.—I probably may not know what that means, but I do not suppose that you maintain that the whole crust of the earth is the result of one instantaneous creation?

Mr. MITCHELL.—I do not say that it was. What is described as the successive creation theory is this (I will take what Professor Huxley himself has said), that there are three great divisions—primary, secondary, and tertiary—and that they indicate three distinct creations. The animals therein—the animals of the cretaceous period, for instance—are essentially distinct from the animals of the carboniferous period, and so on.

Mr. REDDIE.—But although Professor Huxley has said that, it should be remembered that he does not believe in the successive creation theory himself, for he is an avowed Darwinian. (Hear.) Without at all intending to controvert what has been so well said, as to the absolute impossibility of predicting any uniform rate of deposit of mud, from the irregularity of such deposits, as is shown by experience from the system of warping which has been described by Mr. Baxter and Mr. Waddy; and not entering on the proposition of Mr. Warington, that you should bottle off the water of the Nile with the mud in solution in order to ascertain how much might annually be deposited; I will venture to take Professor Huxley on his own argument, that the *same quantity* of mud is brought down every year by the Nile, and that therefore the *same depth* of mud is deposited year by year; and I say that conclusion is totally wrong. I might argue that this is an utter impossibility, if we consider merely the varying depth of the water, as has been pointed out by Mr. Waddy; but even if we assume that the whole waters of the Nile from the first year in which they commenced their flow, down to the present time, have been the same, and have yearly brought down the same quantity of mud, still the depth of the mud-deposit could not possibly be the same now as it formerly was. The fact is, that the basin of the Nile is narrower at the bottom than at the top, so that even if you have the same *quantity* of mud flowing down now that used to flow in former times, the deposit at the bottom of the basin before its width had been increased could not possibly be merely the same as it is now, when the area of the basin which has to be covered by the mud is so very much greater than formerly. The oldest deposits in the narrower basin must necessarily have been deepest. But it is also clear, from what has been said by Mr. Waddy and Mr. Baxter, that the quantity of mud in one part of the stream will be smaller or greater than it is in another part, according to the variations of the force of the currents at different times and places, so that even if Mr. Warington could bottle off the whole of the Nile (laughter), I do not know how he could ascertain the annual rate of deposit in the way he anticipates. With reference to Mr. Mitchell's valuable paper, there is one point to which I would beg leave to take exception, relative to the Denderah planisphere, although I doubt whether any argument of value as regards the present discussion can be founded upon the authenticity of that planisphere. Latrone came to the conclusion that the Denderah zodiac was no older than Nero's reign; but the proof that the Egyptians had a knowledge of astronomy and knew the signs of the zodiac does not depend upon the authenticity of the Denderah planisphere, because other zodiacs can be appealed to, which are undoubtedly of very ancient date. And there is great reason to doubt whether Latrone's conclusion is sound. In the British Museum you will find the signs of the zodiac on ancient stone coffins from Egypt, and also on landmark-stones from Assyria. And these zodiacal signs are not only to be found on Egyptian, but also to some extent upon Central American sculptures. There is, at any rate, a sufficient resemblance in the Mexican figures to show that they cannot be accounted for except by a common tradition and by intercourse between

the peoples. There is one other point in the paper which I fear may tend to weaken what is otherwise a strong array of arguments, and that is what Mr. Mitchell argues in reference to the under-currents of the ocean. Without denying that there may be, or that there are ascertained to be, under-currents in some parts of the ocean, still, so far as I understand the results of recent investigations, I believe they have mostly tended to prove that all is still and quiet at great depths below the surface of the seas. (Cries of "No, no.") I am not disputing that there may be disturbances, sometimes, and in some places; but surely in laying down the Atlantic cable it was found that currents did not exist below the surface, as had been expected. Of course there may be exceptions, such as might be produced by submarine volcanoes and other disturbing causes; and this consideration of such occurrences may, I think, also aid us in the solution of the problem as to the supply of pabulum necessary for the foraminifera of the chalk. In my reply to Professor Huxley I alluded to the due supply of carbonate of lime as a necessity in accounting for the chalk formation; but then I supposed that this might have been supplied to a greater extent at the Creation, when the dry land was first separated from the seas, and also at the time of the Flood, when "the fountains of the great deep were broken up," and when an immense amount of carbonate of lime might probably be thrown into the sea. We ought at any rate to look to some such source, rather than to the quantity that is now being brought into the sea in a settled state of things merely by the present placid flow of the rivers. We ought not to suppose that things have always gone on just as they have been in our own general experience, quietly and systematically; we should rather disregard that experience when we consider even such a series of disturbances as we have heard of during the last few years, especially in the West Indies, and elsewhere in the tropics,—I mean the convulsive tornadoes and cyclones and earthquakes, which may remind us of those greater convulsions whose records are written in history, and the effects of which are surely to be found in many of the geological formations we examine. Take also the case of the Falls of Niagara. It was said by Sir C. Lyell that the wearing away of so many feet of rock by the action of the falls must have consumed a period of 37,000 years or more; but even in our own day it is said there are some extraordinary changes going on in the channel of the river, and probably the Falls of Niagara may sooner or later be perfectly changed in character or even come to an end. I must also here observe that Sir Charles Lyell's theory as to the wearing of the channel by these falls does not account for their beginning at all,—for the rugged dislocation of their channel and formation of the rocks over which they fall; just as Professor Huxley's argument did not account in the least for the formation of the river and the beginning of the deposits of the Nile. Therefore we ought to be very cautious in adopting conclusions based exclusively upon what is taking place now, in our own puny experience, or what may be brought within our own paltry range of observation. (Hear, hear.)

Mr. PATTISON, F.G.S.—There are two great sources of the Nile, one invariable and the other variable,—at least, so Sir Samuel Baker tells us. The

variable one is occasioned by the melting of the snows on the high lands, from which the tributaries of the Nile flow, and, therefore, it is right to say that while it is uncertain as to the quantity of water and the rapidity of the flow, so will it be uncertain as to the quantity of the deposit. Precipitation in the Nile valley in all cases depends upon what is taking place more than a thousand miles off, at its sources, and its supply is peculiarly variable. This disposes at once and for ever of the Nile deposit as a chronometer. (Hear, hear.) The argument has been well disposed of before in the minds of some people, but it seems it has been brought up to do duty again. As regards the geological portion of the paper, while I may say that it is a proper thing to carry the war into the enemy's camp, we ought to do it with great caution, and to carry it on with reserve. Mr. Mitchell has expressed his adhesion to Sir Charles Lyell's view against the successive creation theory. If Sir Charles is not in favour of that view, it is because he wishes to place the time of creation farther from us, because in accordance with his arguments as to geological formation it is a necessity that creation should be further off than most of us put it. But it is not possible to sustain his position. It is not right, I think, to speak of the successive creation doctrine as a theory,—it is a fact. It is a fact that we stand on a deposit of London clay which contains a large marine fauna; and that, not far from where we are, there is, underlying the London clay, an ocean bottom of chalk. There are in some parts evidences of deep seas, in others of shallow seas and banks, and there is not a single fossil in all these deposits like anything we have now, except the foraminifera, and they are small microscopic objects, the examination of which requires a very high power. Therefore it is a fact; and to deny the so-called theory of successive creation is to throw ourselves into the arms of those who are advocates of the Darwinian system. (Cries of "No, no.")

Mr. MITCHELL.—I have not taken that view at all: I have guarded myself against it.

Mr. PATTISON.—I wished to guard Mr. Mitchell against a view at which we should all be shocked. In our day, if we wish to carry war into the enemy's camp on so well-ascertained a thing as geology, we must be very careful as to the position we take, and ought to be certain that we are correct in our conclusions.

Mr. REDDIE.—Sir, the last speaker has laid down the law to us rather absolutely about the certainty of this successive creation theory; and I should not have risen again if he had not done so. But I should like to call the attention of the speaker, as well as of the meeting, to what has been said upon this matter by an authority quite as eminent—namely, Mr. Hamilton, the President of the Geological Society of London. In his annual address for 1865 he stated that "we are daily becoming more convinced that no natural breaks exist between the faunas and the floras of what we are accustomed to call geological periods." (Hear, hear.)

Mr. PATTISON.—By no breaks in the creation Mr. Hamilton meant that from the first there has been gradual progress in the formation of animal life.

Mr. REDDIE.—I wished to be brief, or I might have gone further in citing authorities to refute Mr. Pattison's *dicta*, and I will now do so. I shall now quote briefly from what Professor Huxley has said, *ex cathedrâ*, in the Geological Society as its president. He says, "These seemingly sudden appearances of new genera and species, which we ascribe to a new creation, may be the simple results of migration." This is surely plain enough. Of course Mr. Hamilton and Professor Huxley do not differ from Mr. Pattison as regards any geological facts; but both of them are eminent authorities on geology, and both, it will be observed, reject the "successive creation theory," as to which Mr. Pattison has been so positive. (Hear.)

Mr. MITCHELL.—I have only to reply to one or two things. First, with regard to the Nile deposit, I do feel that there can be no mean rate discovered; and that even if we could discover a mean rate now, we could not be sure that that was the rate that was going on 100 years before. With regard to the suggestion of Mr. Warington for obtaining a mean rate, I think he must have lost sight of one fact that was stated by Sir Gardiner Wilkinson, and that was, that in one year, not upon the plain of Memphis, but on the extreme verge, and near the desert, and upon masses of rock, where he knew there had been no previous deposit, he found a dried deposit of mud three-eighths of an inch thick. If you were to get any data at all, it would not be much better than the data obtained from that source; and yet it does not follow that because it was three-eighths of an inch thick in one year it was the same thickness in another year. Therefore I think little more can be said, either with regard to the Nile, the Mississippi, or what has been well proved with regard to the Ganges,—no chronology can be obtained from the mud of any of these rivers. Mr. Warington's criticism about the chalk was not unanticipated. I had guarded myself very carefully. I said, "The possible increase of foraminifera is only practically diminished by their supply of food, and the rate at which their enemies can devour them." Their supply of food depends upon what happens to exist in the water at the time, and it is only now that we are getting some knowledge of the amount of water in the sea, the depths of the ocean, and other phenomena. There was a theory that the deepest parts of the ocean were no deeper than the highest mountains on the land, but that is a fallacy that has since been exploded. Deep-sea soundings had not been made then, but as soon as they were made it was found that there are depths of eight or nine miles. (A voice: "Where? That is the question.") I think you will find that there are doubts with regard to some of the measurements, but there can be no doubt that there have been measurements of depths of seven or eight miles. (A voice: "Sounded?") The depth of seven miles has been sounded since care was taken to get rid of those errors that originally occurred. With regard to the statement brought forward by Mr. Reddie in reference to ocean currents, I may say that the soundings were made on board ship. They used to employ a heavy shot and a very thin line, but the shot was found to present too great a surface, and it met with opposing currents of sufficient strength to carry it away, so that more line was run out than was necessary

to reach the bottom. But that error was afterwards obviated by taking the soundings from a boat, so that the sailors rowed with the current; and in that circumstance you have incidental proof of the existence of great currents in the ocean. I do not think much reliance is to be placed on what we have learnt as to what I may term the exceptional portion of the ocean bottom, where the Atlantic cable has been laid, because it is laid avowedly upon a plateau which has an average depth of only three and a half miles beneath the surface. If you were to go to either side of the plateau, you would come to deep precipices; consequently the plateau presents exceptional phenomena as compared with the other portions of the ocean. But it has been said that because foraminifera have been brought up from that depth with their shells uninjured, that is, therefore, a proof that the bottom of the sea must be extremely quiet. I may explain as regards these soundings that they were originally made by means of cannon-balls attached to lines. But there was scarcely an instance in which the cannon-ball was brought up again, and the only way in which they first got a knowledge of what was at the bottom was by greasing a piece of metal at the end of the line, and so bringing up a small portion of the ooze adhering to it. An American officer afterwards suggested the use of a quill for this purpose, because of the difficulty that the grease caused in identifying the objects under the microscope; and all that we know now of the bottom of the Atlantic has been made known to us through that source. With regard to the food of these foraminifera, when we know the vast amount of ocean we have to deal with, and if we take it only at three and a half miles deep,—just conceive that more than three-quarters of the earth is covered with water, and I think Mr. Warington will find it will be a very nice problem for him to determine what is the amount of water covering the earth, and how much carbonate of lime it is capable of holding, and we do not know that that proportion may not be increased in the deeper portions of the sea. We know that water at an extreme pressure renders soluble what is insoluble under other circumstances, and we know that the most extraordinary materials and mineral combinations are thrown out by volcanoes; I rather think carbonate of lime forms one portion of those things, and we know that there are volcanoes in the sea. We should remember also that chalk is composed of foraminifera, and also of diatomaceæ, which are nearly all silicious in their formation. Mr. Pattison has suggested that extreme caution should be shown in carrying the war into the enemy's camp. If he will carefully read my paper, he will see how I guarded myself. I simply stated the facts from the progress of geological science as set forth by Sir Charles Lyell and other men professing to be great geological authorities. I produced evidence to show that the tendency of all we knew, as we increased in a knowledge of the earth's strata and their contents, was to prove that the supposed breaks between what were considered successive creations did not exist, and that animals of a high degree of development are being carried down into strata where they were never expected to be found. The tendency of modern geological science is to carry this further. I stated another thing which did not

suit Sir Charles Lyell to insist upon, but which I did insist upon, and that was that the progress of geology shows that many animals supposed to be extinct are not extinct. Mr. Pattison has spoken of the successive creation theory as not a theory, but a fact. What I maintained was, that before it could be brought forward as an undoubted fact a vast deal more must be known than was known at present. I guarded myself very carefully by using the statement of Sir Charles Lyell that we knew scarcely a tithe of the earth's crust, that not a thousandth part of the strata could come within man's cognisance. We know very little of European geology, and there probably has been no place where geology has been cultivated with such assiduity as in this country, and that cultivation has led to the discovery that the supposed facts upon which the successive creation theory existed can no longer be maintained in their integrity. I carefully guarded myself against Darwinism. I believe that in his new book Mr. Darwin introduces us to a new law which entirely contradicts his development theory. (Hear, hear.) I think, in connection with that matter, that it is a very important point that the creatures which are supposed to form the mass of the chalk are identical with some that are existing now in our own seas ;—and how little do we know of our deep seas ! There was an idea some years ago that we were better acquainted with the seas than we are now. The theory propounded by Forbes, that no living animals could exist below a certain depth, has been disposed of by some very awkward facts that have lately been brought to light. We are progressing day by day in these matters ; we should accept facts only, and be cautioned in the name of science not to adopt theories which will prevent the reception of facts if they contradict our theories. We should hold loosely to our hypotheses and collect more facts, even though it is a long time before those facts are sufficiently numerous to allow us to form any conclusion. (Hear, hear.)

The CHAIRMAN.—I may say, as a sailor, that, having seen the deposits in the Ganges, Irrawady, and Yang-tse-Kiang, very little can be said in favour of a supposed law of deposits. In 1842 there was a Chinese war, and our ships went up to Nankin ; ten years afterwards I went up a passage which at that time, according to the charts, was dry land, yet I had eighteen feet of water. That eighteen feet was deposited elsewhere, and this state of things is constantly going on in long rivers, for a particle of earth can be deposited in them and turned over and over again, perhaps twenty times. The same remark applies to those pieces of pottery that have been noticed ; sometimes they may be high up in the deposit, and after being disturbed they may be found lower down. Mr. Pattison has suggested another point, when he alluded to one of the sources of the Nile being in a tropical region. We know that the mountains there are all pointed ; the soft particles have been washed away in long-past ages, so that there is a smaller quantity deposited than there once was. The deposit, therefore, was in times gone by tenfold greater, I take it, than now. In respect of Mr. Warington's suggestion, that the only source of supply of carbonate of lime is to be found in the rivers, we know that the waters cover three times as much area as the land,

and if there are three times as many volcanoes opening out into the water as there are above the water, we have here, I should say, a great source of lime supply. Graham's Island has come up half a dozen times ; islands in the Indian Ocean have come up and gone down again, and we have constant springs or geysers, which would all be adding to the quantity. In addition to all this, what do we really know of the condition of things 3,000 or 4,000 years ago? (Hear, hear.)

The Meeting was then adjourned.