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ORDINARY MEETING, JANUARY 6, 1879.

THE REV. R. THORNTON, D.D., VICE-PRESIDENT, IN THE CHAIR.

The minutes of the last meeting were read and confirmed, and the following elections were announced:—

MEMBERS:—Rev. Mark W. Bird, Haiti; E. J. Statham, Esq., C.E., A.I.C.E., New South Wales.

ASSOCIATES:—Rev. W. Guest, F.G.S., Kent; Rev. C. O. Mules, M.A., New Zealand.

Also the presentation of the following works for the Library:—

"Proceedings of the Royal Society." *From the same.*
"London Quarterly for 1878." *A. McArthur, Esq., M.P.*
"Experience and Revelation." By J. Coutts, Esq. *From the Author.*

The following paper was then read by Mr. T. Karr Callard, F.G.S., the author being unavoidably absent.

THE LAPSE OF TIME SINCE THE GLACIAL EPOCH DETERMINED BY THE DATE OF THE POLISHED STONE AGE. By J. C. SOUTHALL, ESQ. A.M., LL.D., (Richmond, Virginia, U.S.A.).

THERE have been various announcements within the past ten years of the discovery of traces of man in the miocene, pliocene, and glacial strata. The Abbé Bourgeois still contends that he has found worked flints in a bed of miocene date at Thenay; M. Delaunay thought he had discovered, in 1869, traces of the hand of man in certain markings or cuttings on a rib of the *Halitherium fossile*, a well-known miocene species; M. Desnoyers announced the discovery of similarly notched bones, belonging to the *Elephas meridionalis, Rhinoceros leptorhinus*, and other extinct animals in a pliocene bed at St. Prest; Professor Ramorino made a similar announcement with regard to some bones from the pliocene strata of the Val d' Arno; a human fibula, as was stated by Professor Boyd Dawkins, was found some years since under glacial clay in the Victoria cave, in Yorkshire; three or four sharpened sticks, alleged to have been pointed by human tools, were found yet more recently in an inter-glacial bed in Switzerland; besides other instances which it is not necessary to enumerate. It is generally conceded now that most of

these cases must be abandoned, while as to the rest, they are by no means to be relied on; in fact, as the evidence now stands, the careful geologist does not recognize any traces of the existence of man prior to the close of the quaternary period. As the glacial epoch died away, man appeared, and his relics are found in the ancient gravel-beds of the river-valleys of Europe and India, and in the bone-caves of Europe, associated in both cases with the bones of extinct animals, such as the mammoth, rhinoceros tichorinus, reindeer, &c. Since these gravels were deposited in their present position, most of the peat-beds of Europe have been formed, and great changes have taken place in the physical geography of the country. These facts, and the great mass of gravel and loess under which the flint axes are buried, give the appearance of great antiquity to these relics, and have created the present prevailing belief in the vast antiquity of the human race. My own opinion is, after bestowing a great deal of attention upon these phenomena, that they can all be explained in accordance with the recent appearance of man in Europe; but in the present paper I do not propose to go into the subject, save for the purpose of calling attention to a single point. It is admitted that the cave-earth and the river-gravel are post-glacial, and that they were deposited just after the formation of the boulder-clay and the retirement of the ice from the regions which were affected by the glacial influences. If, therefore, we can find any clue to the date of the glacial epoch, we can fix approximately the date of man's appearance in Northern and Central Europe. Various attempts have been made to fix the date of the ice age by calculations based on the depth, and rate of deposit, of the quaternary alluvions, and the rate of recession of the great cataracts of the Niagara and the Mississippi. MM. De Ferry and Arcelin have made such a calculation from the relics of the iron, the bronze, and the stone age, found in the alluvial deposits of the valley of the Saône. By independent observations both of these distinguished archæologists ascertained (as they believed) that the relics of the palæolithic age found in this valley are some 6,000 or 8,000 years old. M. René Kerviler has made similar observations at the mouth of the Loire, and arrived at about the same result. In America, Professor N. H. Winchell has calculated the rate of recession of the falls of St. Anthony, on the Upper Mississippi, and estimates that these falls have been from 6,000 to 8,000 years in cutting their way back from Fort Snelling, where the cataract was first formed at the close of the "second" glacial epoch.

2. The most satisfactory observations of this character have, however, been made by Professor Edmund Andrews on the ancient beaches of Lakes Huron and Michigan, in the United States, which were formed after the close of the glacial epoch. This calculation was based on the recession of the bluffs on the lake-shore, and on the amount of the sand thus washed away by the waves on the north, and deposited at the southern extremity or head of the lake. Dr. Andrews made a calculation based on each of these data, and the result was about the same in both cases, which was, that the total time required for the formation of all the beaches (including the present) has been from 5,290 to 7,490 years.

3. It is, not, however, to any of these calculations that I propose to call the attention of this Society at present; to my own mind there is a simpler and more convincing method of solving this question than any of these, with regard to all of which there may be, in a greater or less degree, a residuum of scepticism arising from a want of implicit confidence in the accuracy of the observations.

4. I propose to fix approximately the date of the glacial epoch without going into any calculations of this kind, but resting the determination on one single, well-ascertained fact, and I believe I can do so to the entire satisfaction of every impartial and unbiassed mind which will lend its attention to the subject.

5. Before proceeding to elucidate the point I have in view, I may mention that the peat formations of Europe present a strong presumptive argument for the recent date of the gravel deposits of the river valleys in which the palæolithic remains are found. This peat is superimposed directly on the gravels, and no doubt commenced to form immediately on—or very soon after—the subsidence of the waters which deposited the loess and gravels which are found high up on the slopes of the valleys. The age of this peat will probably give us the time which has elapsed since the palæolithic age. At the bottom of the peat and silt formations of the Somme valley, M. Boucher de Perthes found the traces of a pile-dwelling, resting immediately on the gravels. The "lake-dwellers" had succeeded the cave-folk of the palæolithic epoch. There is no geological formation to indicate any interval between the two periods, although it is by no means unreasonable to suppose that a brief interval—possibly a few centuries—had passed. The relics found at the bottom of the peat are none of them more ancient than the neolithic age. Much of the peat of Europe we know to be no older than the Roman period.

Objects of metal have been often found in the French and Irish peat at great depths, and at Abbeville, as we are told by Sir C. Lyell, a boat loaded with Roman bricks was found in the lowest tier of the peat. The erect stumps of the beech, three or four feet high, are frequently met with also in the peat-beds of the Somme valley, showing that they had formed with sufficient rapidity to cover up these stumps before they had time to decay. Now, the stumps of the beech, exposed in a damp situation, are especially perishable, and will not stand without decay more than fifty years. Even the stumps of the oak will not last under such circumstances more than one hundred years. The peat, therefore, at Abbeville, must, in some cases, have formed at the rate of three feet in fifty years, or six feet in a century. This may, however, have been under peculiarly favourable conditions, and much of it may have formed more slowly. At the rate of one foot in a century, as the depth in some places is thirty feet, it may all have been formed in 3,000 years—and I doubt if it is older than this.

6. M. Belgrand has pointed out that none of the peat could have been formed during the prevalence of the palæolithic floods, which, he remarks, were extremely violent, and when, he says, the amount of rainfall was so great, that it rolled on the surface of the most permeable soils. M. Belgrand assigns as a reason why the peat could not have formed during the palæolithic epoch, that it never grows in muddy, turbid water; and, he adds, that this fact proves further, that the change from the large rivers of the palæolithic age to the small rivers of the neolithic age, must have taken place *suddenly*. If, he observes, the change had been a gradual one, the valleys would have been filled, not with peat, but with gravel, sand, and alluvium. There is no peat in the valley of the Marne, because, owing to the impermeable nature of a part of its course, it is subject to violent floods of muddy water. So the Seine valley, down to Montereau, contains much peat, but below this point, where it is joined by the Yonne, no peat occurs, because the Yonne, like the Marne, receives its waters from an impermeable district, and is subject to similar floods of muddy water (*Le Bassin Parisien aux ages anté-historiques*).

7. If M. Belgrand is correct,—and Professor Busk states that he has enjoyed unusual opportunities for studying this subject,—the transition from the palæolithic to the neolithic age must have been abrupt, and we must decline to accept the common theory, that there was a great hiatus or gap between these periods.

8. The opinion that a great interval was interposed between the first and second stone ages was based on the alleged change of climate, as evidenced by the presence of such animals as the reindeer in the palæolithic caves and gravels, on the disappearance of such animals as the reindeer, the cave-bear, the cave-hyæna, &c., and the introduction of a new fauna, and on the changes which have occurred in the coast lines and the interior lines of drainage. But it is now admitted that the reindeer was found in Germany in the time of Cæsar (*Cave Hunting*, by Prof. Dawkins, p. 73); the cave-lion, cave-hyæna, and cave-bear are recognized as belonging to existing species; and it is well known that the coasts of Sweden, Denmark, and Norway have been elevated from 200 to 600 feet since the waters of the adjacent seas acquired their present milder temperature—that is, since the close of the glacial epoch, which (having said so much by way of preliminary about the peat), as I shall now proceed to show, corresponded in Scotland and Scandinavia with the inauguration of the neolithic age, and the elucidation of which point is the special aim which I have in view in the preparation of this paper.

9. If I can show that the glacial epoch came down to the date of Robenhausen and the Danish shell-mounds, I shall have brought that mysterious geological episode within the well-defined limits of chronology, and shall dispel the illusion of the 800,000 years given by Sir C. Lyell, in the tenth edition of his *Principles*, or the 200,000 years given in the last edition of that great work, as the date for the retirement of the ice sheet.

10. We are told by Sir C. Lyell and other writers on the subject that there are no traces of the palæolithic age in the North of Europe—that is to say, in the north of England, in Scotland, in Norway, Denmark, and Sweden. In these countries the earliest traces of man belong in every instance to the neolithic or polished stone age; nor, excepting a few cases in Scotland, and one or two in Ireland, have the remains of the mammoth or rhinoceros been found in these countries. We find thousands of stone implements of the second stone age, and innumerable bones of the fauna of the second stone age, but we never meet with any of the palæolithic tools and weapons, and only occasionally, in the Scotch glacial deposits, and in one or two of the caves of Ireland, with the remains of the great extinct animals. "It has been estimated," says Sir C. Lyell, "that the number of flint implements of the palæolithic type already found in northern France and southern England, exclusive of flakes, is not less than 3,000. No

similar tools have been met with in Denmark, Sweden, or Norway, where Nilsson, Thomsen, and other antiquaries have collected with so much care the relics of the stone age. Hence it is supposed that palæolithic man never penetrated into Scandinavia, which may, perhaps, have been as much covered with the ice and snow as the greater part of Greenland is at present." The same statement is repeated in *Archiv für Anthropologie*, where we read that "neither in Scandinavia nor in North Germany have we yet discovered the slightest trace of palæolithic man . . . Scandinavia and North Germany were then covered by the ice" (*Meeting of the Anthropological Society in Munich*, 1874; *Archiv*, August, 1875; *Correspondenz-Blatt*, s. 18).

11. It is clear, therefore, that man was kept out of Scandinavia and Scotland by the ice; when he was permitted to advance, he advanced. When was this? We know by the character of the most ancient human implements found in these countries—in the famous peat-bogs of Denmark, for example,—that it was in the polished stone age. The polished stone age had already set in when the ice retired from Denmark and Sweden, the north of England, and Scotland. Given the date of the polished stone age, and we have the date of the close of the glacial age.

12. The glacial conditions which excluded palæolithic man from the North, excluded him at the same time from Switzerland and the elevated portion of Carinthia, and from Styria. "The farther one recedes," says Count Wurmbrandt, "from the mass of the Alps, the greater is the chance of finding in the caverns traces of palæolithic man."

13. It is the lake-dwellings, not the bone-caverns nor the implement-bearing gravels, that we find in the Swiss mountains. The men of the polished stone age settled at Robenhausen, and Wauwyl, and Meilen, at the same epoch that they crossed the Elbe into Denmark, and established themselves in the valleys of the Forth and the Clyde.

14. What was the date of the polished stone age? It corresponds with the date of the lake-dwellings, with the period of the shell-mounds, with the age of the older stone-graves, and with the earlier stages of the peat. Now, at one of the oldest of the Swiss lake-dwellings—Robenhausen—and that in the lower beds, we already encounter traces of bronze. At Wangen we find great quantities of corn, baked cakes of bread, flax, and perforated stone axes. At Wauwyl we find a glass bead; at Moosseedorf, remains of the dog, pig, sheep, goat, and cow; at Meilen, a bronze armilla and a bronze celt.

In the shell-mounds the fauna implies a date rather more recent than that of the lake-dwellings.

15. If we desire specific figures, the archæologists have undertaken to give them to us. The calculation of M. Morlot, based on the position of the relics found in the gravel cone at the mouth of the Tinière, and accepted by Sir John Lubbock, mentions 6,400 years as the time which has probably elapsed since the stone age was in progress at that point. M. De Ferry estimates the date to have been from 4,000 to 5,000 years ago. M. Arcelin fixes it at between 3,600 and 6,700 years ago. Professor Worsaae, in his *Primeval Antiquities of Denmark*, thinks it was, perhaps, some 3,000 years ago.

16. It is very certain that the more advanced races in Italy were at this time in the possession of the metals. We know this because we find bronze, and glass, and Mediterranean wheat at the oldest of the lake-dwellings.

17. It would in my judgment be a liberal estimate to allow 4,000 years as the lapse of time since the foundation of Robenhausen and Meilen; *and that is (approximately) the date of the close of the glacial epoch in Scandinavia and Scotland.*

18. When the ice-line shut out man from the countries under consideration, palæolithic man, along with the mammoth, and the cave-bear, and the reindeer, lived in the south of England, in France, and in Germany. The glacial conditions had terminated in this southerly region, but still continued in Denmark and north of about 54° latitude in England. Palæolithic man was thus *post-glacial* as regards the region which he inhabited, but lived during the continuance of the glacial epoch in the north. The closing storm of the quaternary period terminated the glacial epoch in the north, and was characterized in the non-glaciated region to the south by the *palæolithic flood*, by which southern England and the northern part of the continent were submerged at least several hundred feet. After this we find at least very rare traces of the mammoth (although the reindeer still lingered until the beginning of our era), and we enter upon the inauguration of the polished stone age—man advancing into Scotland and Scandinavia.

19. The transportation of erratics continued in Sweden down to a yet later date. Sir Charles Lyell observed near Upsala a ridge of stratified sand and gravel, containing a layer of marl evidently formed at the bottom of the Baltic by the slow growth of the mussel, cockle, and other marine species, all of which were of dwarfish size, like those now inhabiting the brackish waters of this sea. These dwarfish shells are not found in the North Sea, nor are they found in the

Danish shell-mounds. The exclusion of the waters of the North Sea from the Baltic, with which they formerly communicated by a strait across southern Sweden, caused the waters of the Baltic to lose a great proportion of their saltness, and occasioned the deterioration in the marine fauna on the east of Sweden. This change in the size of the marine shells has occurred since this strait was closed, and since the creation of the shell-mounds on the Danish coast. Now, the ridge in question, observed by Sir C. Lyell, is 100 feet above the Gulf of Bothnia, and on the top of it repose several huge erratics, which must have come into their present position since the Baltic was divided from the North Sea, and since the epoch of the Danish shell-mounds, in one of the oldest of which an object of bronze has been found.

20. A similar case to this has been observed in Scotland by Mr. James Smith, of Jordanhill, who found a large boulder on the lowest ancient beach of the west of Scotland, which in his opinion could only have come there on floating ice. In the estuarine silt of the corresponding beach on the east coast have been found the bones of the Greenland whale associated with human implements. The presence of this Greenland whale corroborates the testimony of the boulder as to the Arctic character of the climate on these coasts at this time, and we are enabled to form some idea of the probable period when this severe climate prevailed in Scotland from the character of the objects found in the silt of the Carse of Stirling, and with the ancient canoes dug up from the banks of the Clyde. Some of these objects must necessarily have come from the more civilized regions of the Mediterranean.

21. The recent transportation of these erratics illustrates and strengthens my main argument for the recent date of the glacial epoch; for while this epoch had at this time passed away, the seas were still invaded by floating ice, and the climate of the Caledonian coasts had by no means become what it is now. And we learn that no great lapse of time is necessarily involved in such a change of climate.

22. I have mentioned that in Switzerland, among the mass of the Alps, where the ice lingered as late as it did in the north, there are also no traces of palæolithic man, and that in proportion as we recede from this glaciated area we encounter the indications of the presence of man. Now, there is just outside of this Alpine region, near the eastern extremity of the Lake of Constance, a station of palæolithic date, called Schussenried. The fauna and flora observed here were Arctic in character, and the only remains of the extinct animals were

the worked horns of the reindeer. These, we are told, with needles of bone and objects manufactured of nephrite were found "in the glacial clay." The palæolithic hunters had advanced up to the margin of the ice; they left their relics, mingled with the remains of Arctic plants, to be buried beneath the glacial clays. The date of this occupation was, no doubt, just prior to the melting of the Alpine glacier. When that occurred, those who succeeded them advanced into the now habitable valleys of the Swiss mountains, and constructed their pile-villages in the lakes. The settlers at Schussenried had come, as we may suppose, from Asia, and had either brought with them the objects of "nephrite" which (as in the cave of Chaleux, in Belgium) were found among their relics, or they had obtained them by barter from other wanderers from the region of Turkestan or the yet more distant shores of the Lake of Baikal. This nephrite is found nowhere in Europe, and its presence at Schussenried and Chaleux proves conclusively that the cave-men of Europe had relations with the Turanian tribes of Central Asia. We find it again, in numerous instances, in the stone age lake-dwell-ings, showing that the lake-dwellers also had wandered originally from the same distant homes. Is it likely that this traffic between Europe and the Orient existed 100,000 years ago?

23. There is a cave on the northern frontier of Switzerland, near Schaffhausen, which bears the same aspect as Schussenried, and where palæolithic man seems, as it were, to hover on the confines of the neolithic age. I refer to the Kesslerloch. It was here that was obtained, mingled with the bones of the mammoth, musk-ox, reindeer, glutton, lion, &c., that beautiful drawing of the browsing reindeer which is given in M. Conrad Merk's work on the excavations which he conducted at this point; and here the same explorer obtained from the same palæolithic beds the bones of the tame ox, the tame pig, and probably the dog. The remains of the dog were also obtained at the neighbouring cavern of Freundenthal, while "a good deal of pottery," we are told, was found in the cave near Herblingen, in the same region. At Veyrier, on the shores of the lake of Geneva, another palæolithic cave, we observe the absence of the mammoth and rhinoceros, and the presence of the domesticated ox. The fauna is, however, as at the Kesslerloch and Schussenried, an Arctic fauna. It consisted of the reindeer, horse, ox, hog, stag, chamois, marmot, Alpine bear, wolf, &c.

24. These caves indicate that in Central Europe palæolithic man stood outside of this glaciated area of the Alps, advancing

gradually to the foot of the glacier, and possessing by the time he reached the confines of Switzerland some of the domestic animals, vessels of pottery, and beautiful weapons; executing drawings and carvings superior to those from the caves of Périgord; and maintaining commercial relations with his distant kinsmen in Asia. It was the closing years of the palæolithic age; when we encounter man in this region again he has become a lake-dweller; a great storm has passed over Europe; new settlers, doubtless, have come from the great Mongol hives; the mammoth has disappeared—not absolutely overwhelmed, we may suppose, by some sudden catastrophe, as in Siberia, but—gradually exterminated by the new climatal conditions.

25. It is not only not improbable, but it is highly probable, that the men, as well as the animals, of the palæolithic age occasionally passed into glaciated areas, just as we see now on the coasts of Greenland. It may be that this is the explanation of the presence of the bones of the hyæna, mammoth, &c., in the Victoria cave, just beyond that frontier-line which I have indicated in the north of England. Here, too, I may mention, all under the glacial clay, as Mr. Tiddeman reports, were found also the bones of the goat (some of them apparently cut) and the *Bos longifrons* or Celtic short-horn, analogous to the presentation at the Kesslerloch and Freundenthal.

26. Thus, too, we account for the presence of the mammoth and the reindeer in the so-called inter-glacial beds of Scotland.

27. It was mentioned by one of the speakers—I forget now who—at the Stockholm Congress of Archæologists in 1874 that, astonishing as it appeared, several polished stone implements had been found in the boulder-clay somewhere in Sweden. The case is doubtless reported in the proceedings of the Congress. The statement was received with incredulity; but it is no more impossible than that some Eskimo weapon should hereafter be found in a similar deposit in Greenland. Observe, however, that it was a man of the polished stone age who had ventured into this region of the ice. If the case may be relied on, it throws fresh light on my argument for the contemporaneous existence of the glacial epoch and the age of polished stone; it proves that the polished stone age was well under way, and that the men of that period waited with impatience for the still reluctant ice to relax its grasp on the Scandinavian peninsula—or rather, as southern Sweden was then, the isle of Scand.

28. The only possible answer that can be made to all this is, that there was a great chasm—a lost interval of vast duration—between the palæolithic and neolithic ages; that man

suddenly vanished from Europe at the close of the palæolithic age, and did not re-appear here until the neolithic age, when he entered Europe for the second time with some of his stone implements polished. In the interim there is no trace of man or beast. The statement is sufficient to refute the hypothesis. It supposes that (say) 100,000 years ago man (who had previously spread over nearly the whole continent) was annihilated in (or driven out of) Europe; and that he did not again set his foot here for about 95,000 years, when he suddenly appeared in sufficient numbers to re-occupy his deserted hunting-grounds, and to advance even farther north. Now, of course, it is necessary to explain in some sort where man was during this interregnum of the race in Europe. Why was Europe abandoned? Was it uninhabitable? Was there a similar interval in India, where we are told palæolithic implements have been found, and in America, where it is claimed they have also been found? Was the climate of Europe more severe than it had been in the Reindeer Epoch through which man had just lived, and which, according to archæology, was the most brilliant era in palæolithic times? Or did the being who presses now close upon the Pole, in Greenland and Siberia, find Europe too inhospitable during this 95,000 years for the adventurous spirit of a single colony?

29. There is no trace of the fauna of such a period. Where are the remains of the animals that lived in Europe during these 900 centuries? Or, did the beast of the field, as well as man, abandon the continent? Europe, we know, was by no means without its mammalian fauna, even during the terrible Reign of Ice; and the bones of the mammoth and the reindeer are found, we are told, even in the till of Scotland. Neither frost nor flood expelled or exterminated animal life then, and why should the country have been uninhabited after the glacial and post-glacial epochs when their harsh conditions had passed away?

30. Nor are there any geological formations corresponding to any such period. On the palæolithic beds of the caves rest the neolithic beds; and on the gravels rests the peat.

31. A good deal has been said about the change in the fauna; but the present fauna of Siberia is almost identical with that in the same region in the days of the mammoth, and the change from the severe climate of the post-glacial epoch to the present mild climate accounts for the absence of many of the animals common in Europe at that time. As for the animals now peculiar to warmer regions, the cave-hyæna and the cave-lion are both admitted now to belong to existing species; and the remains of the former (as well as the African

lion) have been found in neolithic caves in Spain, while the lion was still found in Europe after the Christian era. The reindeer, the great Irish elk, the Norway elk, the urus, and the aurochs survived to historic times.

32. The animals of the African continent also had access to the European continent at or just before the date of the palæolithic age, as those of Asia had access to America at Behring's Straits, which communication has since been interrupted.

33. So that the fact, therefore, remains, that Neolithic Man was the first who was able to penetrate into Denmark and the North of England, Palæolithic Man having lived previously up to that line. It is admitted by both parties that the Ice was the barrier to palæolithic man. Which is most probable, that man advanced at once, as soon as the ice retired, or that he waited, restrained by some inexplicable cause, tens of thousands of years after it had retired, before he made that advance? I contend that the ice was in these regions down to the neolithic age; the advocates of the antiquity of man contend that it disappeared 100,000 years ago. On this latter theory, what prevented man from advancing? It is to be remembered that the men of the so-called Reindeer Age were extremely intelligent savages, and even if they were suddenly destroyed or driven to another continent, it is not credible that they had no successors in Europe for nearly a hundred thousand years. This would be a missing link in human life indeed.

34. Now these remarks do not imply that there was no line of demarcation between the palæolithic and neolithic ages; there is a very distinct line. There were great disturbances at this time, not only in Europe, but in America and in India and Siberia. The loess deposit in the river-valleys of the United States and Europe testifies to this, as does the sudden destruction by some great flood of the mammoth in Siberia. Perhaps there was a great deal of rain in Europe, incident to the breaking up of the glacier in the North. It may have been these continued rains which led to the destruction of the mammoth in Europe, and even man may have been temporarily driven from the continent. I only contend that there was no great lapse of time—ninety or a hundred thousand years. The destruction of the mammoth in Siberia and the preservation of his remains show that whatever occurred, occurred quickly; there were great forces at work, and the action was violent and paroxysmal. The same indications, as already observed, are given by the volume of the loess and the gravel in Europe and America.

The CHAIRMAN.—I am sure I may convey the thanks of the Institute to the author and also to the reader of this most interesting paper.*

Mr. DAVID HOWARD, F.C.S.—I cannot but think that a very strong protest is needed, such as this paper in a measure affords, against the modern habit of throwing in a few hundreds of thousands of years, whether they are wanted or not. It seems to me that the modern tendency, especially in regard to geological matters, is to refer to periods of hundreds of thousands of years in the same indefinite sense whereby in old indictments a man was stated to have called sundry—that is, ten thousand—people to assist him in his evil deeds. Undoubtedly in the study of geology we necessarily have to deal with enormous periods—periods so vast that they entirely overwhelm our knowledge of time; but it does seem somewhat childlike, because the sense of time is almost lost in the vastness of it, at once to rush into wild numbers which have no meaning. One knows very well that the old Greeks and the modern child, when they get a little way in counting, at once resort to the "myriad" of Homer. When it gets beyond the hundreds, the child has got quite beyond all notion of figures and addition, and I am a little afraid that there is something of the same tendency in modern thought on scientific matters. We get to a period which goes beyond history, and at once jump into myriads. We do not trouble our heads as to the exact counting of Homer. We do not suppose that he seriously meant what we do by the precise words he uses as we repeat them. I

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* Mr. S. R. Pattison, F.G.S., writes as follows in regard to the paper :—I wish to offer a few observations, not to the general scope or conclusions of Dr. Southall's important paper, but to one portion of his argument. He states that the glacial epoch in Scandinavia is contemporaneous with the first flint-tool period. This may have been so. Then, that the second, viz., the polished stone period, occurred as soon as the ice had been removed still further north. This also is most probable. He rightly thus brings down the close of the glacial epoch into the domains of history. But he further says that although there is a very distinct line of demarcation between the two periods, yet the one very quickly followed the other. Now, this, I think, is a weak proposition in a good argument. Whoever studies the gravels and brick-earth of the palæolithic age in the ground below where we now stand, in the valley of the Thames, will see that great intervals of quiet deposit intercalate with other periods of disturbance of local and great action. There are successive platforms of life, indicated alike by shells and bones. I believe that in one of these quiescent stages man first appeared here. He was both heralded and succeeded by floods and "moving accidents." The statement of this, and assigning adequate time, does not require, on the whole, more time than the Mosaic account by inference gives, and thus I beg to offer my thanks for the main argument of Dr. Southall. It is constructed on the lines which the thought on the subject is taking, viz., the bringing down the epoch of the great mammals and of the advent of man, rather than the piling up ages for the latter, and I am glad the Society has had so clear and full a statement of the case. I have offered my remarks to save the wholesale condemnation which might be uttered, on the ground of the untenable (as I think) hypothesis of a distinction between the first period and the epoch of disturbance, which I hold, on the evidence, to have been a portion of it.

cannot help thinking that the future geologist will treat the hundreds of thousands in the very same way. This paper does seem to show very clearly that the glacial period is by no means such a very distant one as many are inclined to suppose. It has struck me in past times in Switzerland, and very forcibly during last summer, when I specially examined one or two of the Swiss valleys, that it is almost inconceivable that any stone whatever can have resisted the action of the weather for the vast period said to have elapsed since the glacial period. If we compare the markings of the stone at the foot of the Mer de Glace, where the glacier has melted away, with the markings of the Ober-Hasli Thal, it is hardly conceivable that the stone can have been left marked by the glacial period, which we find almost as distinct and fresh as the stone which was covered by the glacier only seventeen or eighteen years ago. Undoubtedly granite will stand a long time, of which we have evidence in Cleopatra's Needle, beneath us; but I do not think one hundred thousand years will leave many markings upon it,—(Hear, hear,)—and I cannot think that the granite of the Höllen Platten will stand as long. In the upper part of the Maderaner Thal you have the glacial markings in the most wonderful perfection in the mountain limestone; but I do not think the mountain limestone will stand for a hundred thousand years. The channel markings are wonderfully fresh in this limestone, and we can hardly believe that it is even four thousand years since the glacier has channelled these stones. If we look back to the time, only about eighteen years ago, when the glaciers were rapidly advancing, into these valleys, and find now that two or three miles of glacier have melted away, leaving these beautifully marked stones, and if we consider that there had been but little change in climate there, or in the rest of Europe; we may see how very little change would be required, not merely to alter the glaciers, but almost to sweep them away. I think I am right in saying that the Upper Grindelwald glacier has sunk 150 feet; what, then, would another 150 feet do? It would leave many of the glaciers things of the past. One hundred and fifty feet thick of ice has disappeared with no change of climate, and a very little change of climate would sweep away the great Aletsch Glacier, and the Mer de Glace, and the Grindelwald Glacier. On the other hand, does it not seem possible that with but little change of climate the glaciers might descend and fill the valleys, reproducing the glacial epoch? I do not see any real proof that the glacial period of Switzerland was distinguished by such stupendous climatic conditions as is ordinarily supposed. The change might be consistent with the habitability of the greater part of Europe, and with hardly more variations than we see at present going on in Greenland. Do not let us forget that the glacial epoch is still going on in Greenland. A great part of Greenland has recently ceased to be habitable, and this points to the possibility of the glacial period, stupendous as it was in itself, co-existing with the life of man in the rest of the world, and possibly at no very distant period. It is quite possible that even within historic periods, even within the time of Nineveh and Babylon, there may have been changes on the vastest scale in

the mountains of Europe, caused by disturbances of climate, which may not have affected our ancestors in Mesopotamia. (Cheers.)

The CHAIRMAN.—Perhaps I may help on the proceedings by making a few remarks in addition to those of Mr. Howard. I find in this paper something like a silent protest against an assumption, which appears to me unwarrantable, on the part of persons who seem to be fond of long periods. Some people apparently revel in very high numbers. They remind me of a scientific man I once heard of. He lived in a country village, about eighteen miles from the principal town. He was always dabbling in astronomy, and it was said of him that he had been so accustomed to speak of miles by millions that when asked by a passer-by the distance to the market town, he answered that he did not think it was much more than eighteen millions of miles. (Laughter.) I think that some of these people much resemble this man. They are so much accustomed to speaking of thousands of millions of miles, that they cannot speak of less than thousands of millions of years. Their minds run entirely upon high numbers. When estimating the age of deposits, they always seem to assume that these deposits were made at a uniform rate. I have never found any proof that they were made uniformly. I do not pretend to be a profound geologist, but I have given a little attention to the subject, and I fancy I have found very distinct proof that they were not made uniformly. If I am right on this point the whole foundation of the hundreds of thousands or millions of years is gone; that which is said to have taken a hundred thousand years to form may only have taken fifteen hundred years. Not only is it unfair to assume that all deposits were made at a uniform rate, it is also unfair to say that they were, in every case, made at any rate at all. M. Belgrand asserts that "the change from the large rivers of the palæolithic age to the small rivers of the neolithic age must have taken place *suddenly*." I remember the late Mr. E. Hopkins saying, at one of the early meetings of the Institute, that he knew of a very deep formation being made in this way. Whilst travelling in one of the valleys of the Andes he passed over a small plain in the mountains. Passing by the same place within six months afterwards he found that an avalanche had descended, and that there was a deposit on this plain, which, if examined by a geological eye, would have been pronounced to be the work of some fifty thousand years, while, as he said, it had taken only six months to form. I am glad to see in this paper some protest against these modes of reasoning, which I cannot but think unfair and misleading.

Mr. CALLARD.—There is much in this paper with which I agree, and there are some things with which I do not agree. Although I agree with you, sir, and with the last speaker, and with the author of the paper, that there is no evidence as to 800,000 or 200,000 years back being the time of the glacial epoch, yet these figures are not taken at haphazard, as might be thought from the remarks that have been made. They are based on the theory that the cause of the glacial epoch was a great eccentricity of the earth's orbit. It became an astronomical question at what period we had these great eccentricities. Astronomers

worked out that we had two great eccentricities, one 800,000 years, and the other 200,000 years back, and if the hypothesis had been correct, we had some data for fixing these glacial periods. I have on a former occasion attempted to prove that the eccentricity of the earth's orbit would not occasion the glacial epoch, and that therefore these data have nothing whatever to do with the question. But, whilst I agree with the author of the paper that 200,000 years ago is not the period we are obliged to accept, yet I hesitate in accepting the conclusion of Dr. Southall that the period was as recent as he puts it, the vast changes that have taken place leading me to hesitate. For example, the paper refers to the palæolithic flood which would have swept across Southern England and Northern France —that palæolithic flood which it is assumed deposited the gravels. A flood carrying these gravels is more in accordance with what I have observed, than these gravels being river deposits. Yet I must remark that the time at which these gravels could have been swept across England and the North of France by the palæolithic flood was a time when the Straits of Dover were not in existence, and the geological convulsion necessary for the sweeping of these gravels across England and France, connecting it also with the alteration that has taken place in the Straits of Dover, makes me hesitate in supposing that this could have taken place as recently as the author puts it, for it would bring it to about the time of Abraham. I have not been accustomed to think that such great changes have taken place at such a recent period as that. The author of the paper says :—"If I can show that the glacial epoch came down to the date of Robenhausen and the Danish shell-mounds, I shall have brought that mysterious geological episode within the well-defined limits of chronology" (par. 9). If we take the date of Robenhausen, the author of the paper has put it at four thousand years back,—I do not think he ought to put it further back—Robenhausen is one of the oldest of the Lake Dwellings, and antiquarians have been accustomed to speak of it as of great antiquity. I visited it during last autumn, and, in conjunction with the famous antiquary, M. Messikommer, who resides in that neighbourhood, did some dredging. Judging from the things we brought from the bottom, I should not think Robenhausen a place of vast antiquity. We brought up pieces of pottery, also portions of woven cloth. The people who had inhabited Robenhausen knew something, therefore, about the loom. When I reached home I met with some remark about metal having been found there, and crucibles. I wrote to M. Messikommer to know whether he had met with anything of the kind, and his reply was in the affirmative, but he said the metal he had found was not larger than the head of a pin, it was copper, and was in a crucible. This was enough. If the metal were as large as the head of a pin and he had found it in what was really a crucible, I was satisfied. There were also five other crucibles. When we find six crucibles among the things belonging to these lake dwellings, we must conclude that they knew something about metals, and if they did, this fact takes them out of the stone age. Now the conclusion of the author that the glacial epoch lasted up to the polished stone age, is based upon the

non-finding of palæolithic implements in Denmark, Sweden, Norway, and the North of England. I put one of these implements in my pocket, thinking that as we were to talk of the subject it would be as well that you should see the sort of stones we were to speak about. This implement (*holding one up*) came from the Somme Valley, and a very good specimen of the flint implement it is. The conclusion that palæolithic man did not reach those northern parts is based upon the fact that these implements are not found there, and the same argument is adduced with regard to Switzerland, where, owing to the altitudes, of course it would be much colder. The conclusion is that they are not found there, because the ice kept palæolithic man out. That may be the reason, but we are not tied up to it. There may be some other reason, and I am inclined to think there is another reason. There is a tendency at the present day to confound those periods which are called palæolithic and neolithic. We get a fair definition given to us, and in working it out we depart from it. I should like to read the definition, because it would help us on the subject, and because so very much depends upon it. Mr. Alfred Wallace, in an address given to the Biological Section of the British Association, which met in Glasgow in 1876, says: "As we go back metals soon disappear. We find only tools and weapons of stone and bone. The stone weapons get ruder and ruder, pottery and then bone implements cease to occur, and in the earliest age (*i.e.*, the palæolithic) we find only chipped flints of rude design though still of unmistakable human workmanship." Now, will you refer to paragraph 22 :—

"Now, there is just outside of this Alpine region, near the eastern extremity of the Lake of Constance, a station of palæolithic date, called Schussenried. The fauna and flora observed here were Arctic in character, and the only remains of the extinct animals were the worked horns of the reindeer. These, we are told, with needles of bone, and objects manufactured of nephrite, were found 'in the glacial clay.' The palæolithic hunters had advanced up to the margin of the ice; they left their relics, mingled with the remains of Arctic plants, to be buried beneath the glacial clays."

I would ask, Why does the author call these hunters palæolithic? Why does he call these relics palæolithic? There is no palæolithic implement amongst them. The implements found there, we are told, are needles of bone and implements of nephrite, brought from a considerable distance. They are not palæolithic implements, and therefore I object to this station being called a palæolithic station at all; it is not a palæolithic station, it is a neolithic station. Again, in paragraph 23 :—

"There is a cave on the northern frontier of Switzerland, near Schaffhausen, which bears the same aspect as Schussenried, and where palæolithic man seems, as it were, to hover on the confines of the neolithic age. I refer to the Kesslerloch."

But no palæolithic implements are found there. You do find a beautiful drawing of a reindeer browsing, but that does not belong to the palæolithic age; and I may mention that in Schussenried there were found pottery and a portion of a rope made of the bast of the lime-tree, and also a perforated red bead, like coral. These may seem very slight things to mention, but

they are all-important upon this question : as to whether this is palæolithic man we are dealing with. Bear in mind that in the palæolithic period we only find chipped flints of rude design, and we have got behind the time of pottery and bone implements. I do not blame Dr. Southall, he quotes what others have said ; but I repeat that the things spoken of are not palæolithic at all, and that the district over which palæolithic implements are found is very much more limited than this paper would lead you to suppose. Dr. John Evans, who is perhaps the greatest authority on this question, published in the year 1872 a book on the flint implements of Great Britain. He said there had been no trace up to that time of any flint implement of the palæolithic type being found north of the river Ouse and its tributaries ; and Mr. Flower, in a paper read before the Anthropological Society in the same year, stated that the farthest north at which any of these implements had been found was in the Wash, and in its neighbourhood. I think the argument in this paper would have been stronger if Mr. Southall could have said that flint implements were found everywhere except in those places he has named, where the ice may have been supposed to have kept man out. But it is not so. If I were asked where flint implements are to be found I should say : " In the gravel and in the gravel drift, and nowhere else." They are found in the Somme Valley—this one came from the Somme Valley ;—they are found in the neighbourhood of Salisbury, but it is in the gravel again ; in the Ouse they are found, but still in the gravel ; in Norfolk and Suffolk, at Brandon and Hoxne they are found,—indeed, wherever found it is always in the gravel or the gravel drift. Palæolithic man was unlike neolithic man, who travelled about and carried his implements with him ; palæolithic man, if there was such a being, and you must allow me the doubt, made his implements in the gravel, and where he made them there he left them, and not one has been found anywhere else. Such being the case, it gives me some ground for raising the question whether the non-finding of the implements in Scandinavia, in Denmark, and in Scotland, was not owing to the fact that there was no man to take them there, and that neolithic man is the first evidence we have of man at all in Europe. (Cheers.)

Rev. J. James.—There is one remark I wish to make as to the way in which many geologists when making their calculations have ignored other sciences. Astronomy, no less than some other sciences, ought to be taken into account by them. It certainly should, I think, be considered the great sin of modern men of science that they limit themselves to a particular branch and ignore all others. Physical science they boast of, and they confine themselves to it, whereas it seems to me to be not a matter of boast but rather of shame that they should ignore the other recognized sciences.

Rev. A. F. Muir.—I wish to make a few remarks, in the capacity of an inductive reasoner, as criticising the conclusions at which scientific men have arrived on this question. It seems to me that the induction has been altogether too narrow, that it has been confined to a certain class of phenomena to the exclusion of others. Mr. Callard has fittingly said that astronomical data bear very importantly upon this question, and

in most reasoning on this subject they are entirely ignored. Might it not be suggested, that not only astronomical but other data, which may not at present seem to bear so much on the question, might come into play upon it in the same way, and that the proper spirit would be one of delay, waiting till we had sufficient data on which to proceed? I will give an instance of how I have seen that recent investigations are affecting this question. In the current number of *Scribner's Magazine* there is a very interesting paper by a Californian naturalist upon lakes, which he classifies. The lakes of which he speaks are chiefly those in the neighbourhood of the Yosemite Valley. Among the mountains of that region a most interesting study of the genesis of lakes may be made. He states that the silting-up of many of these glacier-formed lakes is a matter of very short duration—that it is done comparatively quickly. The writer gives a plate showing how the margin of a lake, which a few years back had evidently had steep rocky shores dipping into the water, was now gradually being fringed with meadow-land, formed by the silting of the mountain sides, worn down by streams and atmospheric action; and in all probability in a few hundred years, if so many, that lake will be entirely filled up. Consequently we infer that in similar situations, as in Switzerland, where these lakes have been formed and wholly or partially filled up, leaving a deposit of mud or gravel, the remains found therein cannot have been so very ancient. There are other arguments of great importance to prove that there is, as Mr. Callard suggests, no such being as palæolithic man. It seems to me that the society would have gained very much if Mr. Callard had communicated the ideas I have heard from him in private, when he has gone further than in what he has said to-night, and I think with very good reason.

The meeting was then adjourned.

Mound-Builders in America.

"One of the most interesting questions in American archæology has long been that of the age of the 'mound-builders.' Modern views seem now opposed to a prehistoric date for these people. Amongst other American workers who have inclined to the more recent date of these structures may be mentioned S. F. Haven, who considered the ancestors of the present Indians to have been the authors of these erections, and Dr. P. J. Farnsworth, who believed that the mound-builders were identical in race with the historical Indians of North America. On this subject a paper read before the Congrès International des Américanistes, 1877, by M. F. Force, has just been reprinted in pamphlet form by Clarke & Co., Cincinnati, 1879, entitled, 'To what Race did the Mound-builders belong?' The following are some of the author's conclusions:—That so far as indications are given by the growth of vegetation it is not necessary to hold that any of the works were abandoned more than one thousand years ago. That the absence of all tradition concerning the mounds among the recent Indians is no proof of their great

antiquity, as Indian tradition is short-lived and evanescent. Although the advent of De Soto with his armed followers, pillaging and ravaging the country, must have been calculated to make a deep impression, yet, when Europeans visited the country a century and a half later, they found not a vestige of a tradition of De Soto. Finally, Mr. Force considers that the mound-builders were tribes of Indians, more advanced than the Algonquins or the Dakotahs, but much less advanced than the Aztecs or the Peruvians, and on the same plane with the Pueblo Indians, and that they were living in full prosperity in the time of Charlemagne. Mr. Force reviews the evidence as to their antiquity derived from an examination of crania from these mounds, and endeavours to prove that either the skulls were not obtained from the mounds under consideration, or in other instances would not bear the conclusions based on their examination."—*Nature*, 27 Feb., 1879.—ED.

DR. SOUTHALL'S REPLY.

[COMMUNICATED.]

I AM inclined to think that Mr. Callard is right in his idea that the so-called flint implements obtained from the river gravel are natural, and not artificial, forms. I have suspected this to be the case for several years, but it is as yet by no means proved. The archæologists will not listen to any such suggestion ; I therefore did not raise this question.

My object, setting out with the artificial origin of these forms as a *concessum*, was to show that we have in the areas over which these implements are distributed in Europe, a clue to the date of the Glacial Epoch. The gravels in which they occur are admitted to be Post-glacial, and the implements are therefore, of course, posterior in date to the close of the Glacial Epoch. Beyond a certain line in the north of Europe they do not occur : I undertook to show that this was due to the fact that palæolithic man was kept out of Denmark and Scotland by the ice, and that man advanced into these regions when the climatic conditions permitted him to do so—namely, at the beginning of the Polished Stone Age. And I then pointed out that this gives us the date of the retirement of the ice in Denmark and Scotland—that it corresponded with the beginnings of Robenhausen and Moosseedorf.

But Mr. Callard here interposes the objection that these flints in question are not artificial in their origin, and would infer that the argument presented by me is, therefore, unnecessary, as well as unsupported by the fact assumed or accepted as true.

If Mr. Callard is right in this view of the non-artificial origin of these flints (and I think it not improbable that future investigation will show that he is), then the antiquity of man ceases to be connected in any way with the age of the river-gravels, and we get rid of the most difficult point in this whole discussion.*

* If these so-called implements were really manufactured by some primeval race of men, they ought to be found under varying conditions and in all locali-

But, supposing this to be the act, in that case we have still to deal with the *Bone-Caves* of the so-called Palæolithic Age, which occur all over Central

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ties. But in Europe they are always, I believe, found (1) in the *river-valleys*, or associated in some way with the floods of the Post-glacial epoch. They are always associated also with beds of *sand*, generally beneath such a deposit. 2. They are always of *flint* (in a few instances, perhaps, of *chert*), and have been washed from the beds of *chalk* which are found in the Somme Valley, at Hoxne, at Bury St. Edmund's, at Brandon, at Herne Bay, at Reculvers, at Fimber, at Fisherton, &c. 3. The specimens which are offered as spear-heads, axes, &c., have been selected from hundreds of other fractured or worn flints, admittedly of non-artificial origin, and which pass insensibly into the more perfect forms. 4. *No other* implement or utensil has ever been found with these rude flints. If man left these implements in the river-valleys, every other trace of him has perished; there are no implements of bone, horn, ivory, wood, no trace of pottery, charcoal, clothing, ornaments, pigments, nor any of those relics, other than stone, which abound in the caves.

In precisely the same geological position similar implements have been found in old river-beds in India; the only difference being that the material here is quartzite instead of flint.

In the valley of the Delaware, United States, in the same geological position, similar forms of a stone called *argillite* have been recently found. Here, as in Europe, the chipped pebbles occur in great numbers, more or less nearly approached in form to the accepted specimens, which accepted specimens are culled out as the artificially-formed ones from hundreds of inferior specimens admitted to be mere natural forms.

In the Upper Mississippi Valley, near the Falls of St. Anthony, in Minnesota, Prof. Winchell has found in the past three years, in a *Pre-glacial* deposit, certain chipped fragments of *quartz* and *chert*, some of which have been pronounced to be "unquestionably" of artificial origin. These implements, however, "vary in thickness, from that of *paper*, and the size of one's *finger-nail*, to one and two inches across, of irregular angular forms"; and out of "three quarts" of these chips gathered, there were only "eight" specimens "that could be thought to have a designed form." It is also stated that in one instance, near the mouth of Little Elk river, "the veins of white quartz from which these chips were originally derived, were observed to split into angular pieces similar to those taken from the surface sand of the plain, under the action of moisture and frost." (*Geological and Natural History Survey of Minnesota*, 1877, p. 57.)

Innumerable fragments of broken flint are found, according to M. Zittel, in the Libyan Desert, which, as he remarked at the Stockholm Congress of Archæologists in 1874, have been fractured under the action of the sun. A certain proportion of these specimens appeared to him (in which opinion M. Desor concurred) to have been shaped by the hand of man.

There is one other remarkable locality where fractured stones occur in great numbers, some of the fragments closely resembling the so-called palæolithic flints from the river-gravels of Europe. In the volume of Hayden's *Geological Survey of the Territories* (*U.S.A.*) for 1872, there is a paper by Prof. Joseph Leidy, giving an account of the "Remains of Primitive Art in the Bridger Basin of Southern Wyoming," at the base of the Uintah Mountains. The flat-topped hills or terraces occurring in this basin are familiarly known as *buttes*, many of which are covered with drift materials, partly from the Uintah Mountains, and partly composed of the harder materials from the terraces themselves. The mountains have furnished materials of sandstone and quartzite, while the buttes have contri-

and Western Europe, as well as in Italy and Spain, but *never* in the more northerly parts of Europe, that is to say in Denmark, Scotland, Sweden, or Norway, or beyond a certain line in the north of England.

It will not affect my argument whether we call these primitive cave-men palæolithic or neolithic; we never find their traces in the North of Europe. We find neither the implements which characterise the lower beds of the caves of Périgord, or Belgium, or England, nor the bones of the extinct animals—I mean the mammoth, the rhinoceros, the cave-bear, the cave-hyena, the musk-ox, &c. Why is this? I must give the same reason that I gave in the other case—both man and brute were kept out by the ice. The climate in the North did not permit the cave-men of the Mammoth—or, if it is preferred, the Reindeer—epoch to advance. The ice still lingered in Denmark and Scotland. When did it retire? It retired, as is evidenced by the most ancient relics found in these countries, in the Polished Stone Age. And we arrive at precisely the same conclusion which we reached before.

In the caves of the so-called Palæolithic Age no polished stone implements are ever found, and as archæologists use the terms neolithic and polished-

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buted fragments from thin seams of brown and striped jaspers, and black, yellowish, and grey flints, and not unfrequently nodules of chalcedony and agate. Some of the plains are thickly strewn with these splintered stones. Some of these specimens Prof. Leidy pronounces to be unquestionably "rude implements of art;" while, as he remarks, "the vast numbers of similar stones to be found on the plains and buttes near Fort Bridger, and their gradation to undoubted accidental fragments with which they are mingled, alone renders it improbable that they should be considered as such." The learned professor figures a number of the specimens, which bear a strong resemblance to the palæolithic types.

It is very evident from these facts that the great bulk of these fractured stones—flint, chert, quartzite, argillite, jasper (all with the exception of argillite, varying forms of quartz, or pure silica)—are of non-artificial origin, and the presumption, to say the least, is very strong that *all* are so. If nature can produce the chippings (as is unquestionable) which appear on the flint and argillite nodules, where is the process to stop? If she can produce a specimen that is so much like the so-called artificial specimen that it can hardly be distinguished from it, why may she not have originated both specimens?

I will add only one other remark. It is well known that flints, believed by many archæologists from their artificial appearance to have been shaped by the hand of man, have been found in Pliocene and Miocene deposits, as, for example, in the Pliocene strata of the valley of the Tiber, and in the Miocene strata near Pontlevoy, in France. Now these flints, if their stratigraphical position is correctly described, are undoubtedly non-artificial, and if so, the quaternary flints of the Drift gravels are also probably non-artificial.

I present these considerations as an argument going to show that Mr. Callard is correct in his views on this point, but I doubt if they will appear conclusive to all minds; they are certainly not so regarded by archæologists like Mr. Evans and Mr. Boyd Dawkins, and for the present we must be content to await additional light on the subject. They open up a most interesting line of investigation, which I trust will be followed up by such competent observers as Mr. Callard.

stone as interchangeable and equivalent to one another, I object to the application of the term "neolithic" to this period. When we descend to a later period—that of the Lake-Dwellings—we encounter at once the polished implements, as we do in the peat-bogs of Denmark and in the carses of Scotland.

The faunas, too, in the two cases are entirely different: in the oldest bone-caves of France, England, Germany, the fauna consists of the mammoth, the rhinoceros tichorinus, the cave-lion, the cave-bear, the reindeer, the musk-o , the urus, the aurochs, the horse, &c.; in Denmark, and Scotland, and Sweden, the fauna associated with the earliest remains of man consists of urus, aurochs, red-deer, brown bear, sheep, tame ox, wild boar, fox, dog, &c., the same as the fauna which occurs in the peat of the Somme Valley and in the Swiss lake-dwellings.*

It may be said that the bones of the mammoth have been found in Scotland: this is true; but they have been found in the Glacial formation denominated the till, showing that the animal penetrated into this region in the midst of the Ice Age—wandered off occasionally, no doubt, from the more genial regions farther south, where he existed at that time as the contemporary of man. It was probably only an occasional straggler that crossed this inhospitable line; and it is possible, as I intimated in my paper, that man may have done the same thing. But this was the exception, not the rule; all that I meant to insist on was, that in general the ice and the snow in these northerly regions constituted a barrier to the men and to the animals who left their remains in such caverns as Moustier, La Madelaine, Chaleux, Kent's Hole, and the Kesslerloch, and to point out that we find that barrier removed in the Polished Stone Age.

Mr. Callard remarks that he would hesitate to believe that the palæolithic flood can have been as recent as I represent it, because that flood must have occurred at a time when the Straits of Dover were not in existence. I am not sure that the palæolithic flood was not subsequent to the formation of these straits, but, waiving this, I would observe that an elevation of the sea-bottom some 150 feet would unite England with France at this point; and I would farther call attention to the fact that the dwarfish shells of the mussel, cockle, and other marine species, occur on a raised beach at Upsala, in Sweden, 100 feet above the sea; and at Linde, 130 miles west of Stockholm, they are found at a height of 230 feet above the sea. The significance of this fact is this, that these shells were deposited in their present positions since the date of the Danish shell-mounds, where the marine shells are much larger. The mussel, and the other species represented in the Kjökken-möddings, were much larger than they occur now in the waters of the Baltic, because these waters were at that time much more salt than they have been since the broad channel was closed which formerly connected

* The remains of the reindeer are found occasionally in the peat-bogs and in neolithic caves, but it is a rare occurrence; during the "Reindeeer epoch" the animal seems to have abounded all over Central and Western Europe.

the North Sea with the Baltic along the line of the lakes Mälar, Hjelmar and Wenern. Those straits were open when the Danish fishermen occupied the sites of the shell-mounds, and the date of these shell-heaps is proved by the fauna to be fully as recent as that of the lake-dwellings. Indeed, in one of the oldest of them (near Kallundborg) objects of bronze have been found. Since this date—which was hardly more than 3,000 years ago—the straits referred to have been closed, and the land at Linde, in Sweden, has risen 230 feet.

I may add, that the coasts of Norway have risen 600 feet since the temperature of the adjacent seas was very nearly what it is to-day.

If these changes have occurred within so recent a period, why should there be any difficulty about the Straits of Dover? The elevation of the land at Linde must have occurred since bronze implements found their way to Denmark—that is to say, within 3,000 or 3,500 years.