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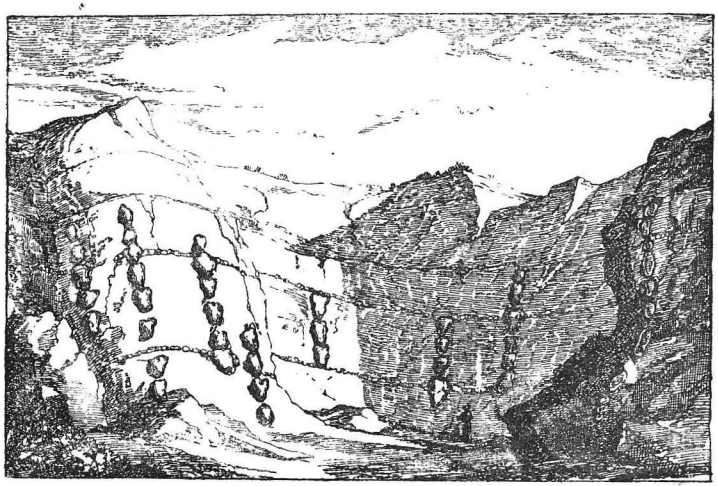
ORDINARY MEETING.*

T. CHAPLIN, ESQ., M.D., IN THE CHAIR.

The following Paper was read by the Author :—



VIEW OF A CHALK PIT AT HORSTEAD, NORFOLK, SEPT., 1, 1838.
Showing the Paramoudras in their natural position, but so buried in the chalk that the shape of each individual stone cannot be distinguished.

ON THE ENIGMATICAL FLINT BODIES BEARING THE NAME PARAMOUDRA AND WHICH ARE ONLY KNOWN IN THE CHALK OF NORFOLK, AND THE CHALK OF ANTRIM. By EDWARD CHARLESWORTH, ESQ., F.G.S., &c.

"OF what materials is the Earth composed, and how are those materials arranged?" Such is the brief but most pithily worded proposition with which the late Sir Charles Lyell commences the first edition of the small duodecimo bearing the name "Elements of Geology," and which supplemented his great work called "Principles of Geology," the publication of which at once gave its Author a position in the field of scientific research, and philosophical generalisation founded on research, which no future progress made in the same channels of human investigation is ever likely materially to modify. Of what materials then is the

* 26th Session.

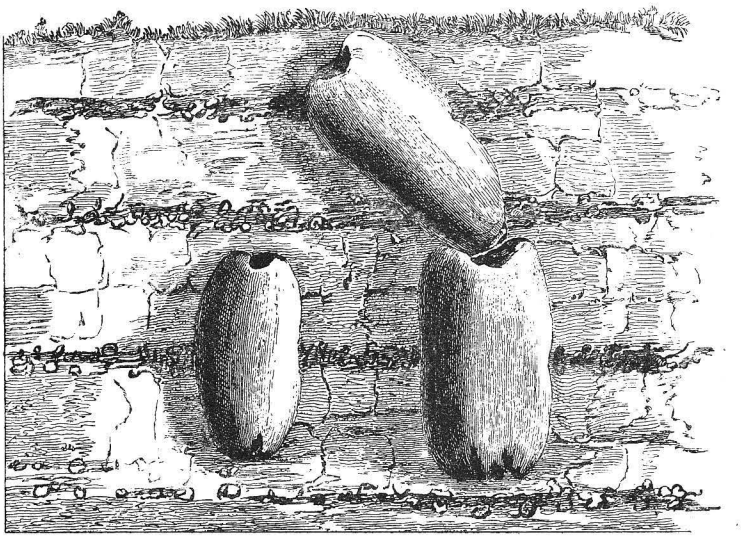
Earth composed? This evening I propose to invite the Members of the Victoria Institute to the consideration of some of the phenomena presented by one of those materials, and that one is the substance known to mineralogists by the name "Silex." This substance under a great variety of forms has a large share in the constitution of that small portion of the Earth beneath the surface accessible to human observation, and which, for the sake of convenience rather than correctness, is called its "*crust.*" In this crust then we find as forms of Silex, the beautiful substance known as Rock-crystal, also Jasper, Carnelian, Chalcedony, Agate, and many others; but the form of Silex with which everyone is familiar, and which in its mass exceeds by millions of times all other varieties of Silex put together, is *flint*, a material which in many parts of England is found so valuable in road-making and in building; many of the churches in East Anglia owing their high preservation and beauty to the flint stones so largely used in their construction. A geological student going into one of the numerous chalk quarries which are to be seen on both sides of the Thames between Gravesend and London, has his attention at once arrested by horizontal strata of flint stones imbedded in the chalk; these flint strata being separated by three or four feet of chalk. Attached to these flints and sometimes enclosed in them are various fossils of the same species as are found in the chalk, consequently the chalk and the flint, though so entirely distinct mineralogically, must be regarded as one geological formation. But flint does not characterise the entire thickness of the chalk, being found only throughout its upper portion. There its presence furnishes the geologist with both mineral and zoological evidence for the identification of the upper portion of the great chalk formation; and while on the one hand, mineralogists and chemists have occupied themselves in attempting to explain the solution of flint in an ocean which must have been so highly charged with lime, and its precipitation from time to time in the condition we now find it, paleontologists, attracted by the numerous organic bodies it preserves, have naturally been led to speculate upon what may be termed the cretaceous aspect of a mineral to which they owe the possession of some of the most interesting objects of their study. Now flint is by no means peculiar to the chalk formation, but the conditions under which it comes under our notice in chalk, constitute a phenomenon of the highest possible scientific interest.

Werner, one of the distinguished names in the early history of geological science, started the theory that during the deposition of the chalk, a quantity of gas was set free, which being unable to escape, gave rise to numerous cavities in the chalk, and that the flint being precipitated from its solution was infiltrated into these cavities. Dr. Buckland refuses to accept this theory, and suggests that probably flint and chalk were deposited together in the form of viscid fluids; and that as the process of consolidation went forward, these two substances separated by cohesive or attractive forces operating uniformly upon the respective atoms of each.

The late distinguished chemist, Dr. Turner, referring to this subject in the Philosophical Magazine for July, 1833, observes that although if we now reduce flint to the state of powder no sensible portion of it is dissolved when steeped in water, yet at the moment of its separation from a state of combination with some other mineral body, it is readily soluble: but that while so dissolved the slightest cause will occasion it to revert to the solid state. It is, then, only necessary to assume that the cretaceous ocean had access to rocks in the constitution of which silex was an ingredient, and that these rocks were undergoing decomposition. The silex at the moment of its separation from the other rock constituents would be taken up and disseminated through the waters of the ocean, and its subsequent reversal to the solid form is attributed by Dr. Turner to the emission of gases from the decomposition of organic bodies.

Thus far I have been dealing with the great geological problem of flint as found in chalk. I now pass on to submit to the members of this Society the consideration of a most remarkable enigma connected with the chalk-flint story, which has been an enigma ever since when in the transactions of the Geological Society for 1816 it was brought under the notice of philosophers and men of science by the great geologist, Dr. Buckland. The title of Dr. Buckland's paper is "*Description of the Paramoudra, a singular fossil body found in the chalk of the north of Ireland.*" These singular fossils, says Dr. Buckland, are found in many of the chalk-pits from Moira to Belfast and Larne, but are most numerous at Moira. They are known at Belfast by the name Paramoudra, a word which I could trace to no authentic source, but shall adopt. They have, I believe, never yet been found in the chalk of England, except at Whitlingham near Norwich, whence there is a good specimen in the Geological Society

equal in size to the largest I have seen in Ireland, being about two feet long and one foot in diameter. No two of these bodies are found exactly alike in all their proportions. Their length commonly varies from one to two feet, their thickness from six to twelve inches. Their substance in all cases is flint. These bodies have a central aperture passing through their long diameter. These apertures are always filled with chalk of the same nature as the chalk in which the flint masses are imbedded. Then Dr. Buckland goes on with descriptive details which I pass over, but I quote the Doctor's account of the position of these bodies. The Paramoudras



THE PARAMOUDRAS AS SEEN BY DR. BUCKLAND IN THE CHALK OF ANTRIM.

sometimes lie horizontally, sometimes inclined or erect. They are generally insulated, and altogether unconnected with the ordinary horizontal strata of flints which accompany them. Sometimes the extremities of two specimens are found in contact; but this seems to be the result of accidental juxtaposition, not of any original connexion. But I mention it because an idea used to prevail at Belfast that the Paramoudras are occasionally found linked together in a kind of chain.

The animal history of these fossils, says Dr. Buckland, is involved in much obscurity, as they display no traces of

internal organization sufficient to develop the habits and character of the original bodies whose external features are so distinctly preserved. The central aperture was calculated to allow water to have access to the interior of the animal, as is the case in many hollow sponges which have large single tubes passing into their centre, and usually closed at their lower extremity. It is possible that the Paramoudra, having a tube with two apertures, may have possessed a character intermediate between a sponge and an ascidian. I have broken many of these fossils, and only in one found the smallest trace of organization, and this trace, I think, must have been due to an accidental inclosure of a foreign organic body.

The mineral history of the Paramoudra seems intimately connected with that of many other spongiform bodies which we find in chalk-flints. In all these cases the organic bodies thus preserved appear to have been lodged in the matter of the rock while in the state of a compound pulpy fluid, and before that separation of the flinty from the calcareous ingredient which has given origin to the flints in chalk.

The date of Dr. Buckland's above communication on Paramoudras to the Geological Society was at a time when my opportunities for making geological observations were limited to the out-door excursions of my nurse, for I was then passing through that interesting stage of human evolution known as the long clothes period; and, as in that day, to record in print any facts or opinions brought forward in discussion at the meetings of the Geological Society was regarded as an inexcusable misdemeanour, I am wholly unable to find what kind of reception was given to Dr. Buckland's paper on the occasion of its being read at a meeting of the Geological Society. But what greatly surprises me is this—that Dr. Buckland after the publication of his remarkable discovery seems never to have followed it up. I should have expected that the Doctor, filling as he did the Chair of Geology in the University of Oxford, would have felt it incumbent upon him at an early day after his return from Ireland to have travelled to Norwich and in the chalk quarries of Whitlingham and Horstead have seen how far the Paramoudras of the Norfolk chalk agreed with or differed from the Paramoudras of the chalk of Ireland; and then I should, moreover, have expected that he would have put himself in correspondence with foreign geologists and have learned whether Paramoudras were known in more

parts of the world than England and Ireland. But I am compelled to infer that in the matter of the Paramoudra enigma, Dr. Buckland had no desire to trouble himself further by an attempt at its solution. Happily, however, for the interests of geological science, Dr. Buckland had a contemporary of a very different stamp, and that was Sir Charles Lyell. It was not possible that so remarkable an incident in geological history as massive flint tubes occurring in the chalk of Antrim and Norfolk, and utterly unlike any mineral or organic forms of matter previously known, could be passed over by the lynx-eyed Sir Charles Lyell. Accordingly we find in the volume of the "Proceedings of the British Association" for the year 1838, that the following paper by Sir Charles was read before the Geological section.

"It has long been known that near Norwich the horizontal beds of flint nodules are crossed by perpendicular rows of much larger flints. These larger and vertical flints are locally called 'Potstones,' and are the same as those which occur in the chalk of Ireland, and which have been described by Dr. Buckland under the name 'Paramoudra.' At Horstead, about six miles from Norwich, an excavation has been made nearly half a mile in length, through 26 feet of white chalk, covered by strata of sand, loam and shelly gravel to the thickness of about 20 feet. The rows of vertical 'Potstones' are remarkable for their number and continuity. It is affirmed by those who for more than twenty years have been engaged in quarrying the chalk, that every column of these vertical flints has been found to extend from the top to the bottom of the chalk, so far as the quarrying has been carried downwards. The columns occur at irregular distances from one-another, usually from 20 to 30 feet; and they are not portions of continuous flints in a vertical position, but piles of single flints. Few of the flints are perfectly symmetrical, and they are very unequal in size, usually from a foot to three feet in their vertical length. At the point of intersection between these vertical and the ordinary horizontal lines of flint there is no mutual interruption or shifting; but the two are united as if both were formed at the same time. Each Paramoudra is not a solid flint as is the case with the horizontal flints, but contains within it a cylindrical chalk nucleus, which when deprived of its flint envelope has the form and smooth surface of a tree when stripped of its bark. This internal mass of chalk is much harder than ordinary chalk, and does not crumble under the action of frost. It is seen at the top and the bottom of each Paramoudra. A ventriculite sponge was observed on one occasion in the chalk-nucleus. In conclusion, Sir Charles Lyell invites geologists, who reside near Norwich, to study these phenomena more minutely, and, adverting to the late discoveries of the distinguished German philosopher, Ehrenberg, declares his

expectation that the origin, both of the vertical and the horizontal lines of flint, would be found to be intimately connected with the fossil remains of infusoria, sponges, and other organic bodies."—Sir Charles Lyell, British Association Report for 1838.

As I shall have occasion to refer later on to Sir Charles Lyell's subsequently published views as to the nature of the Paramoudras, for the present I will content myself with remarking that nothing can be more vague and unsatisfactory than saying that flints, whether disposed in vertical or in horizontal lines, are intimately connected with infusoria, sponges and other organic bodies. A precipitation of flint from its solution in sea-water, whether thrown down as silicious jelly or as extremely fine powder, would necessarily be mixed up with the various organic bodies lying on the sea-bed; and in this way all flints may be spoken of as connected with the remains of oceanic life. But how does that connection, if admitted, give us the smallest insight into the nature of a Paramoudra, whether regarded as a single massive flint tube or as a chain of such tubes?

Dr. Buckland's suggestion that a Paramoudra was a link connecting sponges with ascidians, however inadmissible in the present condition of natural history science, was at all events something tangible to be accepted or rejected; but the view put forth by Sir Charles is so vague as to be utterly worthless.

I now proceed to treat of a most important step in the Paramoudra history—one that has been most strangely neglected, and which involves the entire remodelling of the story as known up to 1840. There is living at the Woodlands, Norwich, a magistrate, and enthusiastic antiquarian and geologist, named Fitch (Robert Fitch, Esq., J.P., F.G.S., F.A.S., &c., The Woodlands, Norwich). Sir Charles Lyell, in his Paramoudra article, bearing date 1838, expresses a hope that Norfolk geologists will be led by it to study the Paramoudras more minutely. How far the hope thus put in print influenced my friend, Mr. Fitch, I cannot say, but not long after 1838, Mr. Fitch, with whom I had long been intimate, took me to Horstead, and there to my no small surprise shewed me that the core of chalk in the Paramoudras when broken-up displayed a central green tube; this tube, surrounded with the chalk core, reminding one of a candle wick immersed in tallow. I at once urged my friend to make his discovery public. This he did in the pages of my own journal, the new series of the Magazine of Natural History for 1840, and I added the following note:—

"Can this curious tube be in any way connected with the aggregation of flinty matter forming the Paramoudral column? If the Paramoudras were originally sponges or organic bodies of any kind, how comes it that when broken they present no organic structure or, at any rate, nothing which distinguishes Paramoudra flint from flint as it occurs in the nodular flints of the horizontal layers. After spending a morning in the Horstead Quarry, with Mr. Fitch as guide, and breaking up a number of the Paramoudras, we found the tube present in every case; sometimes, however, so nearly obliterated as to be only traceable by the discoloration of the chalk round its original site. The tube varies in diameter from that of a quill to a finger. The wall of the tube is generally of a green colour and about as thick as the skin of an apple. The substance which fills it is chalk. Dr. Bowerbank finds it to consist of silicious particles.

I believe the sole merit of this interesting discovery rests with my friend Mr. Fitch."

The late Professor Morris, of University College, in his most valuable list of all British Published Fossils, classes the Paramoudras as sponges; but this location of these bodies as sponges carries no weight with it, because Professor Morris was compelled either to adopt the position assigned by their original describer, or to locate them somewhere else. He being unable to adopt the latter course, naturally was content with following Dr. Buckland, and included the Paramoudras as sponges.

A period of about 50 years having elapsed, Sir C. Lyell renews the consideration of the Paramoudra enigma, and in his "Students' Elements of Geology," writes as follows:—

A more difficult enigma is presented by the occurrence (in the chalk) of certain huge flints . . occurring singly or arranged in nearly continuous columns at right angles to the ordinary and horizontal layers of smaller flints. I visited, in the year 1825, an extensive range of quarries on the River Bure, near Horstead, . . which afforded a continuous section a quarter of a mile in length, of white chalk, exposed to the depth of about 26 feet and covered by a bed of gravel. The Potstones (Paramoudras) . . were usually about 3 feet in height and about one foot in transverse diameter, placed in vertical rows like pillars, . . usually from 20 to 30 feet apart. . . These rows did not terminate downwards in any instance which I could examine; or upwards, except at the point where they were cut off abruptly by the bed of gravel. . . Dr. Buckland has described very similar phenomena as characterising the white chalk on the north coast of Antrim. These

masses of flint often resemble in shape and size the large sponges popularly known as 'Neptune's Cups,' which grow in the Seas of Sumatra; and if we could suppose a series of such gigantic sponges to be separate from each other, like trees in a forest and the individuals of each successive generation to grow on the exact spot where the parent sponge died, and was enveloped in calcareous mud, so that they should become piled one above another in a vertical column, their growth keeping pace with the accumulation of the enveloping calcareous mud, a counterpart of the Horstead sponge phenomena might be obtained.—*Vide* Sir Charles Lyell, "Students' Geology," Edition 1885, page 251.

Sir Charles is no longer vague. His new version of the Paramoudra enigma is not that the Paramoudras had in common with all chalk flints some obscure connection with sponges; but that they really are petrified sponges identical with, or allied to the well-known gigantic tropical sponge, popularly called "Neptune's Cup."

Now, how a man of the vast amount of knowledge acquired during a long life devoted to all the branches of study bearing on Geology, could commit such an utter absurdity as to identify Paramoudras with Neptune's Cup sponges is to me as great an enigma as is the Paramoudra itself. The Paramoudra is a cylindrical massive tube open at both ends—if water be poured in at one end, every drop of it runs out at the other. Neptune's Cup sponge is a cup crowning the summit of a massive stalk. If water be put into this cup there it remains, and as this Cup sponge is of a tough leathery nature wholly unlike the sponges in domestic use, I doubt if water would soak through the sponge at all. But whether this be so or not, the comparison of a cup to a tube open at both ends is so at variance with common sense, that to refute the comparison would be wasting words.

I have now, in dealing with the Paramoudra enigma, quoted Dr. Buckland, Professor Morris, Sir Charles Lyell, and myself, the last quotation being a supplementary note to the publication of the highly interesting and important discovery made by my friend, Mr. Fitch. Mr. Fitch wisely, as I think, limits himself to facts, and does not attempt to make his discovery throw light upon the nature of the Paramoudra. But the Members of the Victoria Institute may naturally ask whether, or not, I have any opinion as to the origin of the remarkable bodies I have this evening brought under their notice. Now, my reply is this. We have before us two conditions in the Paramoudra

story, either of which in my opinion is sufficient to negative the sponge, or any other hypothesis which refers the Paramoudras to some once living structure. One of these conditions is the entire absence of structure. Now, I am well aware that when Ventriculites and other forms of sponge life, which flourished in the cretaceous ocean, are found invested by flint, the sponge and the flint are sometimes so intimately blended, that though the shape of the sponge is perfectly preserved, the flint mass on being broken displays no sponge structure. But this obliteration of sponge structure is an exception to the general rule; whereas, in the case of the flint Paramoudras, if we assume them to have been forms of life, the total obliteration of their structure by silicious petrifaction is invariable; for Dr. Buckland admits that the only indication of structure in breaking up Paramoudras which he has ever met with was probably due to the accidental introduction of some foreign body.

The other condition is this. The Paramoudras, if once living, are all of adult growth. The difference we find in their dimensions is only such as holds good through all adult forms of life.* What, then, has become of the Baby Paramoudras? Quarrying the chalk in the Norfolk Pits has been turning out Paramoudras, we know, for three quarters of a century, yet, up to this time, no Baby Paramoudra has come to light. The absence of structure, and the absence of Baby Paramoudras, are alike fatal to the organic theory adopted by Dr. Buckland and Sir Charles Lyell. Then we must fall back upon a non-organic origin for the Paramoudras, and here I fully admit that the discarding one hypothesis involves the necessity of attempting to frame another, and to frame that hypothesis is a task beyond my powers of speculative mineralogical construction.

Lastly, what is to be thought of the remarkable discovery made by Mr. Fitch, and the mysterious silence of Sir Charles Lyell, respecting it.

When the proprietorship and editorship of Mr. Loudon's "Magazine of Natural History" passed into my hands, Sir Charles Lyell was one among a band of distinguished men of science who became contributors to its pages.

* Mr. Horace B. Woodward, F.G.S., in a letter to the Hon. Secretary of the Victoria Institute says: "At St. James' Pit, Norwich, Mr. Whitaker and myself noticed one Paramoudra nearly 7 feet long, which extended through two bands of flint-nodules."

The supposition that Sir Charles was ignorant of Mr. Fitch's discovery cannot, therefore, for a moment be entertained, and his wholly ignoring that discovery is, to me, incomprehensible. Mr. Fitch's discovery is an additional factor of mystery in the Paramoudra story. Are we to regard the green tube occupying the centre of the chalk core, as an original part of the Paramoudra, or was it of subsequent introduction? It is impossible to overrate the interest of this strangely neglected feature in the Paramoudra story. But here I must bring my discourse to an end, hoping that what I have put before the Members of the Victoria Institute, may have the effect of renewing interest in the attempts to solve one of the most remarkable enigmas in the whole range of geological science.

SUPPLEMENTARY NOTE BY THE AUTHOR.

Ehrenberg, the great authority on Microscopic Life, states as the result of his examination of Paramoudra flints that it exhibits no sponge structure, consequently he rejects the Sponge theory, but accompanies that rejection by a theory of his own, one that appears to me as little satisfactory as the theory advanced by Sir Chas. Lyell (see *Annals of Natural History*, 1893).

Dr. Hinde is the author of an illustrated catalogue of the fossil sponges in the Cromwell Road Museum, a work which will prove of the greatest possible value to students. In this work there is no reference to Paramoudras, an omission which can hardly be regarded as otherwise than a denial that these bodies are sponges. But on the other hand, Prof. Sollas, now of Dublin, a high authority on both recent and fossil sponges, unhesitatingly treats of the Paramoudras as representing the former existence in the cretaceous sea of Neptune's Cup sponges (*Annals of Natural History*, 1880). Now, this living sponge gives us four factors for comparison with its alleged fossil representative—

First, Neptune's Cup has sponge structure throughout its entire mass;

Secondly, it has the essential character of a cup;

Thirdly, the cup may be said to crown a massive stalk;

Fourthly, the stalk has a base of attachment or rather of implantation.

But, a Paramoudra is a hollow flint cylinder, under the microscope shewing—

No sponge structure;

It is not a cup;

Nor has it a stalk;

Nor a base of attachment.

Where then do we find one single point of correspondence between the two?

Surely the authorities who claim Paramoudras as petrified Neptune's Cup sponges should be able to tell us on what they base the agreement between them.

The CHAIRMAN (T. CHAPLIN, Esq., M.D.) having moved a vote of thanks to the Author,

Professor J. LOGAN LOBLEY, F.G.S., thought we might obtain a clue to the solution of the difficulty if we remembered the behaviour of certain accessory mineral substances in masses of rock, the particles of such minerals having a tendency to aggregate together, thus for instance, one found in the chalk, besides its flint nodules, aggregations of metallic matter, iron pyrites.

Professor HENSON agreed with Professor Lobley.

The Rev. W. B. GALLOWAY, M.A., thought we must look for some force of regular operation in the case of Paramoudras.

Mr. J. T. DAY agreed with Professor Logan Lobley, and thought his view was supported by some investigations which proved that the chalk lying centrally between two 'ayers of flints contained the highest percentage of silica, that in other parts being partly absorbed by the layers of flints, and the inference was that some organic matter, a twig or stem, had served as a nucleus in the case of the Paramoudras.

Other members having spoken, the Author replied.

Votes of thanks were passed to the Royal College of Physicians and to the Geological Society, for the specimens kindly lent to the Institute for the purpose of illustrating the subject under consideration, and the Meeting was then adjourned.