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I.—*On the Organic Remains found in the Himmalaya.*—*By Capt.* J. D. Herbert, *Dep. Sur. Gen.*

[Read before the Physical Class Asiatic Society.]

The more elevated portions of the earth's surface have always in a particular manner attracted the attention of geologists, in consequence of the greater developement in which rocks are there found. The level plains are every where composed of vast accumulations of the more recent debris, which conceal in a great measure the nature of the materials forming the crust of our globe: in mountainous countries only it is that the nature and order of the strata can be observed. In level countries these are hid from our view by the thick coating of rubbish with which the destructive agencies always at work have gradually covered them.

The greater the elevation the greater has been supposed to be the interest attached to geological investigations; yet this is not always the case. When the Wernerian theory was in vogue, the occurrence of marine organic remains at great elevations was necessarily considered a point of considerable interest; but since other views (to say the least, equally probable) as to the possible origin of the present inequalities of the earth's surface have become current, the occurrence of such phenomena at this or that elevation has ceased to form a discussion of the same interest.

But though the question of the altitude at which shells are found has lost much of its original interest, it does not follow that no interest of another kind may not attach to it. In fact, from the zeal and perseverance with which the history of fossil remains has been recently pursued in Europe, many points of inquiry have sprung up which are calculated to interest the geologist in a very high degree. By comparing the shells found in the same rocks at different places and again in different rocks, much of the obscurity which had concealed what is called the order of superposition in the newer strata has been dissipated, and a strong light thrown on this most interesting branch of geology. In this way fossil remains have come to be considered as the most certain means of determining the true place of a formation in the general order of superposition; and mineral composition (in which indeed it was always known there was great latitude), is again frequently altogether overlooked. Thus the lias of the Alps could never be recognised by a common observer as the same formation with the lias of England; but the fossil remains

found in both being identical, and some of them peculiar to that member of the newer strata, no doubt is left of their correspondence in order and position, at least in the mind of the experienced geologist.

The application of this test to rocks in the same neighbourhood must at once be admitted as legitimate; that it may be extended even to rocks of the same country most will concede; but in pushing the principle still farther, it will become a subject of consideration what is the postulatum on which the deductions from it rest. In applying it to rocks found on opposite sides of the globe and in climates the most different, do we not assume that similar animals must have lived in widely separated localities, in climates sometimes directly opposite? Again, what do we mean by similar animals? Does the term include the *same species*, or merely different species of the *same genus?* Here are questions which can only be answered by an extensive induction. If answered affirmatively, they would afford a certain clue to the investigation of many curious facts in distant countries; but they unfortunately require for their answer those very facts they are intended to illustrate. Geologists have perhaps too hastily adopted the least troublesome view of the question, and have, I think I may say, assumed what should have been the object of their inquiry. It has in this way, for instance, been attempted to connect the strata of the Himmalaya in which organic remains are found, with the secondary and tertiary strata of England. Geology is not however yet ripe, for the admission without question of the opinion on which this conclusion rests; and many more facts must be collected before it can be viewed as even probable. In a question of this nature, in which very distant localities are concerned, we should find mineral composition, notwithstanding its latitude, a safer guide; for as Humboldt observes, the rocks are the same in every climate, but not so the organic productions whether animal or vegetable. What is meant is, that though rocks oscillate much, their oscillations are performed round a mean type, which is the same in every country however different the locality. Even the oscillations preserve a certain resemblance; and however great the varieties may be of a rock found for instance in one country, similar types will be found wherever else that rock is extensively developed. But the case with organic productions is very different. Amongst them the instances are few of an individual adapted to live in different climates; and even in the same climate, how often do we observe individuals confined to a limited range, where the arrangement of nature has been undisturbed by man? Perhaps however the opinion, which would advocate the comparison of mineral composition as a means of determining the identity of the supposed member of any formation, is applicable with less modification to the primary and secondary than to the tertiary class of rocks; although I conceive we are far from being able to pronounce positively, without a much more extensive collection of observations than we can yet command.

The tertiary strata in Europe have been fully studied, owing to the abundance and variety of the organic remains found in them; but we have as yet few notices of these strata in other parts of the globe. These tertiary strata have hitherto been found in countries of moderate elevation: it is not unlikely then, should the conjecture which traces them in the Himmalaya mountains prove to be well founded, that the examination of them at such enormous elevations may be attended with the discovery of various particulars of interest, and it is much to be desired that the subject could be prosecuted with that energy which its importance warrants. But for this very reason I would argue against our receiving too easily the opinion, which from the examination of a few shells would at once jump to the

conclusion, that such a rock belongs to the lias formation of England, such a one to the oolite, &c. and rest satisfied with this conclusion, as if no more were to be learned. As a stimulus to inquiry; as a means of engaging in it those who have an opportunity by observation of supporting or overturning such an opinion; we need not object to its circulation; but we should be careful to take it for what it is worth and for no more. We should not adopt as a dogma to be believed, that which should rather be considered as a query to excite discussion and examination.

An accurate and complete history of the organic remains which have yet been discovered in the Himmalaya, would be a useful memorandum for the geologist. To make it really useful, however, it ought to contain drawings of every remain, and particularly full and accurate information as to the locality, which should be fixed physically and geologically. The execution of such a work is to this extent however I fear nearly impracticable; for of the remains found many have been sent to England, and are doubtless distributed beyond the power of an unassisted individual to trace. As however it is important to make a commencement, I shall here throw together such particulars as I have had the means of learning, in hopes that my imperfect account may stimulate others to supply my deficiencies, and particularly to correct (if I have made any) my mistakes.

I may commence with a very general and cursory view of the geology of these mountains, so as to show what is the real bearing of the question of organic remains, and what is its real interest.

The Himmalaya mountains may be geologically divided into 3 distinct zones; which in their fully developed character are sufficiently well defined, though it may often be difficult to trace the exact boundaries.

On first approaching them from the plains, sandstone is the rock met with. It is of an argillaceous and frequently conglomerate character, containing immense quantities of rounded stones. It is distinctly stratified, and dips pretty regularly to the N. E. the inclination of the strata being seldom more than 20° or 25°. To what formation of Europe this sandstone is analogous, appears to be still doubtful. I am myself inclined to think it must correspond with the newer red sandstone, but my want of acquaintance with European rocks, except in books, of course leaves my opinion open to dissent. This sandstone seldom attains an elevation of more than 3500 feet above the sea, or 2500 above the plains at its feet.

To the sandstone succeeds the zone of schists. These are at first argillaceous, afterwards micaceous, and latterly taleose and chloritic. This description however must not be taken too literally; for there are often beds of argillaceous or taleose or chloritic schist in the middle, while micaceous schist may be found on either border. But the above is the general arrangement. This zone attains great elevation. Its lowest level may be about 1500, its highest 7 or 8000. These schists are always stratified, but it has appeared to me that the stratification is more irregular and more difficult to trace than in either of the other zones. Beds of limestone and potstone are found in this tract, and towards its superior limit beds of hornblende schist. In the former occurs the copper mines of these mountains. The mica slate of course often passes into quartz rock, which sometimes covers a great extent of country. It is frequently intersected by veins of a porphyritic rock, composed of quartzose arenaceous base, with irregular crystals of hornblende disseminated.

This tract is physically remarkable for attaining its greatest elevation on its southern and northern extremities, while between it is of less height, forming in fact, if the mean surface only be considered, a sort of trough or basin. A pecu-

larity of geological structure accompanying this is the disposition along this lowest level of granitic tracts or *nuclei*, each of comparatively small extent, frequently putting on the appearance of veins, and distributed at intervals along the line from the Kalee to the Sutluj. Generally these granitic *nuclei* being in the lowest tract, are themselves not very high; but an exception is found in the Chúr mountain, which attains the elevation of 12 000 feet, and forms the summit of a very lofty, extensive, and well defined range. Gneiss is occasionally met with on the borders of these patches of granite, but never extensively; and beyond it again succeeds the micaceous schist.

The third zone is that of the Himmalaya proper, the snowy range itself; and it is composed, without an exception that I know of, of gneiss. The stratification is always marked, generally regular, and like the sandstone dips to the S. W. The consequence is, as has been often noticed by travellers, that the plainward faces of these mountains are steep and precipitous, while those to the N. E. are of easy declivity. Professor Jameson describes the stratification of great mountain ranges as dipping on each side towards the summit, but nothing of this kind occurs in the Himmalaya. It has been also said, I believe by the same authority, that all lofty mountain ranges are granitic; but neither is this true of the Himmalaya: the highest peaks are every where composed of gneiss, the strata of which may be clearly distinguished, when bare of snow, through a telescope. Granite has no where been found except in veins, and these veins are generally small with one exception. This is at Wongtoo on the Sutluj, where the granite is of some extent, though still, as I satisfied myself, but a large vein.

The gneiss is of very various character, as far as colour and grain are concerned, though always very regular, consisting of the usual ingredients united in the usual proportions; garnets, schorl, kyanite, carbonate of lime, green quartz, and hyacinth, are the most ordinary imbedded minerals. A speck of native gold has been found in a specimen from one of the granite veins.

If we now consider what precedes, we shall perceive the interest attaching to the question of organic remains. 1st, None have ever been found in the sandstone, with the exception of small patches of lignite pretty generally distributed through it. This is so far in conformity with its character in Europe, where few if any organic remains have been found in it. Nor do I know of any having ever been detected in any of the schists, which it is evident from the above description belong to the primary class of rocks. The argillaceous schist does however, where in contact with the sandstone, put on very much the appearance of gray-waeke, and a very great proportion of it is well defined gray-waeke schist, in which rock organic remains have been found in Europe. And though I have above stated, that no organic remains are to be found in this rock, I must not omit to mention, that Dr. Govan has described a limestone occurring in the gray-waeke slate as containing organic impressions; though no details on this subject have ever been laid before the public. Recently too the same gentleman has transmitted to a friend in Calcutta a portion of the same rock, said to contain an impression of a lizard's tail. The resemblance however was, I think, but faint, and the general opinion appeared to incline to scepticism with regard to the real value of this organic remain. But with every deduction made on these scores it would perhaps have been only more correct to have said, that organic remains have been found *very rarely*, if at all in this rock.

Granting even the veritable character of these remains, they are found only on the southern limit, and at no great distance from the sandstone, where it may be

supposed the rock has not its primary character yet fully developed. But in the superior part of this zone, and in the gneiss zone, nothing of the kind has ever been detected.

The gneiss zone being stratified and dipping at no great inclination to the N. E. the consequences to be expected are, that in proceeding to the north eastward the same succession of strata would be found, but at greater elevations. And this is the fact, although the development of the rocks to the north is not equal in extent to those on the south side. Micaceous schist with its associates gradually give way to gray-wacke slate or gray-wacke, which rocks are found at very great elevations: limestone with organic remains is found in beds in these rocks, and at such an elevation, that the tertiary strata may be expected to occur at very great heights, and even the superficial deposits which have been called *diluvium*. It may be proper here to note, as the source of many erroneous ideas on the geology as well as physical character of the Trans-himmalayan countries, that the term *plateau* or *table land* cannot with any propriety be applied to such part of them as we have any means of visiting, or even of viewing at a distance. This subject I have fully discussed in my report of the survey in which I was engaged by order of Government: it may be sufficient here to state, that the country is mountainous and uneven, intersected by deep ravines, the beds of torrents, or by river gorges of great depth and steepness, and that any thing like a plain or moderately undulating valley of a mile square is not to be found. In fact, when it is considered that the tract in question is occupied by the Sutluj and Indus with their branches, it may well be supposed to be any thing rather than a plateau.

The occurrence then of the organic remains we have lately had before us, would seem to be some warrant for our expecting the tertiary strata much nearer to the zone of gneiss, than judging from the analogy on the southern side we should expect to find them. As a consequence of this proximity to the crest of the highest chain of mountains in the world, and the small inclination of the strata, they must be situated at higher levels than these rocks have yet been observed to occupy. As a corollary we may also expect, that the superficial and most recent deposits will be found at a great elevation; and in this way there may certainly be a central plateau or table land far beyond our frontier, of which however we can scarcely expect ever to have a glimpse.

Having thus cursorily illustrated the physical structure and geology of the tract in question, I proceed to notice the several occurrences of organic remains with which I am acquainted.

The first notice of organic remains from the Himmalaya mountains was I believe derived from the fact of the Gunduk river bringing down, with the stones in its bed, specimens of *Ammonites*, the *Saligrami* of the Hindus. As nothing was known at the time of the geology of the mountains, the fact attracted little notice, and indeed was only known perhaps to those who interested themselves in the history and nature of Hindu observances. The next occurrence in point of time was the fact learned by Europeans resident in Kemaoon, of the occurrence of fossil bones as well as of *Ammonites* in the interior of the snowy range, and their circulation in commerce as an article of export. These bones were called *Bijli ca har*, lightning bones, as the expression may be translated; and they were valued, not only as charms, but as medicines; belonging in the latter case to the class of absorbents. As they consist chiefly of carbonate of lime, it appears that they were not unfitted for this office. Who was the first discoverer of these bones, and appreciated the interest belonging to them in Europe, I cannot positively say; I rather think how-

ever it was Captain S. Webb, then surveyor in Kemaoon. He took home a collection of them, which from an incidental notice in the *Reliquiæ Diluvianæ* we learn was inspected by the Rev. Dr. Buckland, whose speculations on the subject of bones found in caves excited so much interest some years ago. Mr. Traill, Commissioner in Kemaoon, subsequently made what appeared to me a very interesting and valuable collection, which was presented to Mr. H. T. Colebrooke. These I had an opportunity of examining, and I shall here state what occurred to me, as well as what I could learn of their locality, &c.

They consisted of bones of sizes, including crania or fragments of crania of different animals. One specimen, which was a very perfect one, was a cranium apparently of a goat or deer, the cavity of the skull being occupied with a congeries of crystals of calcareous spar. In like manner, the larger bones had their cancellæ filled with these crystals, which appeared to have taken the place of the medullary substance. All these bones were completely mineralised, being converted into carbonate of lime, with occasional incrustations of an arenaceous or coarser carbonate. Dr. Buckland says of those he examined (the bones taken home by Captain Webb), and of which he referred several to a species of horse and a species of deer, that they were unchanged except by the loss of their animal ingredients, being dry and absorbent like grave bones. Mr. Traill's collection was evidently of a very different nature: the mere handling them was sufficient to convince any one of the complete change they had undergone.

Sometime afterwards I was fortunate enough to make some acquisitions of the same kind by Mr. Traill's assistance, and as far as I could understand derived from the same localities. These, as they were described to me, were on the northern face of the ridge which separates the basin of the Ganges from that of the Sutluj, and not far from the town of Dumpu. This ridge is several days journey beyond the line of snowy peaks forming the zone of greatest elevation. On one of the passes examined, the Uta Dhura, elevated 17000 ft. was found a bed of limestone containing organic remains though not well defined—such a limestone as in Europe would be called transition. This limestone belongs to a gray-waeke schist, which succeeds a micaceous schist, following in order the Himmalaya gneiss; yet these bones were asserted to have been brought from a spot not 5 days journey to the north of this, and considerably elevated above the bed of the Sutluj. I am sorry I have not the means of submitting this collection to the Society, but the accompanying two specimens may give some idea of the nature of these remains. One appears to be a fragment of a bone of a large animal—it is, as is evident from its weight, completely mineralised. The other is a specimen of silicified wood. Whether it came from the same place I know not, but the collection contained several similar specimens.

From the same people from whom these bones were obtained, great numbers of *Ammonites* and of *Belemnites* were obtained. The former when unbroken were ellipsoidal shaped masses of a black iron clay, approaching to the nature of clay slate. Outside they are perfectly smooth, as if rounded by attrition, but on breaking them the impression of the *Ammonites* is discovered. Many of them, however, which externally were not distinguishable from the others, yet contained no impressions in their interior. Concerning the locality of these or of the *Belemnites*, I never could get any clear information beyond the fact of their being found North of the range before-mentioned, which, as it is the boundary of the Honorable Company's territory, was likewise that of my investigations.

With the exception of these particulars, all that we know or have heard of organic remains in the Himmalaya, we owe to the spirit and persevering enterprize of Dr. Gerard. His repeated visits to the different places where these remains are to be found must have made him fully acquainted with all the circumstances. As one of the most interesting of his collections has been recently under the consideration of the Class, and as all his letters accompanying them have been read at our meetings, it would be at once useless and impertinent in me attempting a history of his labours and discoveries. I may however state, if it be only to connect these collections with the others, that they consist of *Ammonites* and *Belemnites* like the others, and in addition of *Orthoceratites;* that like them they come from beyond the region of the schists, which succeed to the Himmalaya gneiss in going northward; and that, in addition to the above, there are what I have seen in no other collection, rocks apparently formed entirely of shells, and containing several species in the most perfect preservation. These latter I need not say are those which have been made the subject of a recent report read before the Class. Dr. Gerard has however, I believe, never met with any bones.

I may conclude this meagre notice with the expression of a hope, in which I am sure the Class will join with me, that Dr. Gerard will shortly be able to communicate to us the particulars of his discovery as to locality, &c. and that by this means there be assured to him the honor of being the first discoverer, which considering his indefatigable zeal in the examination of the tract in question and the many years of his life he has devoted to it, we should be sorry to see snatched from him by a later observer, who was indebted for his knowledge of the phenomena, and his examination of them, to the liberal and communicative spirit which Dr. Gerard has always manifested.

Note by the Secretary.—The accompanying plate, has been etched from the more finished drawings of Dr. Gerard's fossil shells, prepared to be printed with the Rev. R. Everest's memorandum upon them in the Asiatic Researches. These organic relics are generally in so mutilated a state that few of the characteristic types are discernible, and the difficulty of naming them is increased by the want of works of reference on fossil conchology. Much uncertainty therefore still prevails in the names assigned, and it is hoped by circulating the figures in the GLEANINGS to elicit further opinions on the subject from those who make conchology their peculiar study. Those also who reside among the hills may, by seeing what species the cabinet of the Society possesses, be better able to select fresh varieties, and complete in time this interesting series of Himmalayan fossils. We address ourselves more particularly to Dr. Gerard, to whom we already owe so much, and who has promised a geological section of the Spití valley, in which they were discovered by himself.

References to Plate XVII.

1. (*a*) Numerous blocks of gray siliceous limestone—(or calcareous tufa, containing 50 per cent. of reddish sand), filled with shells and casts of a small inequivalve eared bivalve, resembling the small *Pecten* of the York lias.

b and *c* are mutilated specimens of a larger variety of *pecten*, probably the same shell in a more advanced state.

2. (*a*) An unequivalved bivalve shell with a deep furrow on the back, the substance of which is generally changed into crystalline carbonate of lime, and in a single specimen into ironstone; it is imbedded in a hard slate of a dark gray: the lower valve is frequently crushed as in figure 2 (*b*). Mr. Everest supposes

them to belong to the genus *Producta*, and compares them to the *Producta Scotica*, depicted in Ure's Geology.

3. Specimens of a plaited variety of *Terebratula*, some detached, others imbedded in a matrix of bluish gray limestone (containing 6½ per cent. of pure white sand). These shells differ little from those so abundantly found in the inferior oolite near Bath

4. Many detached specimens of an equivalved transverse bivalve, transversely striated, and the valves crenulated on their interior margin (*c d.*) Its external shape is similar to that of a short variety of *Unio* to which it was at first referred, but Mr. Everest points out the absence of lateral teeth and ridge, and inclines to refer it to the genus of fossil *Trigonia*. Some larger varieties resemble the *Venus* and *Donax*. Many of the shells have undergone considerable pressure. The figure *b* and *c* are too triangular in the drawing; the lower part should be more rounded.

5. Small very transverse equivalved bivalves of a black colour, belonging apparently to the genus *Modiola*.

6. A variety of *Arca*. The drawing somewhat too thick.

7. Imperfect fragment of a large shell, which may be a species of *Donax? or Ostrea?* Mr. Everest supposes it an *Inoceramus?*

8. This and several of the following specimens are varieties of *Ammonites*, of which the specific names cannot be assigned for want of books and plates of reference. It resembles the *Ammonites stellaris* of the lias in Ure's Geology.

9. Resembles the *Orbulite* or the *Nautilacea* of Lamarck.

10. Bears a strong resemblance to the *Nautilus pompilius* of the same author. Parts of the white original shelly substance adheres to the dark gray cast, and exhibits minute transverse striæ on the interior surface, which are less marked on the interior cast—the substance of the shell is exceedingly thin.

11 and 12. Shew the distinct characteristics of the two commonest species of *Ammonites:* they are frequently mineralized by pyrites and iron clay.

13 and 14. Represent the rounded nodules when first broken; they belong to the same species as fig. 12. The annular ridges divide off into loops on the back of the whorls, (*Ammonites vertebralis* of Sowerby?)

15. A species of *Cirrus*.

16. This shell corresponds very closely with the plate of Sowerby's *Ammonites subradiatus* given in Lamarck, which is a fossil of the Bath oolite.

17. A variety of *Ammonites* not determined.

18. *Helix:* resembles the *Turbo ornatus* of the lower oolite. (Sowerby.)

19. Cast of a patelli-form shell.

20. The drawing of this figure is faulty; the cone has too large an angle. It appears to belong to the family *Turbinacea*, genus *Turritella*.

21. Undetermined, perhaps *Conus marmoreus?* L.

22. *Orthoceratites;* enclosed in a nodule of iron clay.

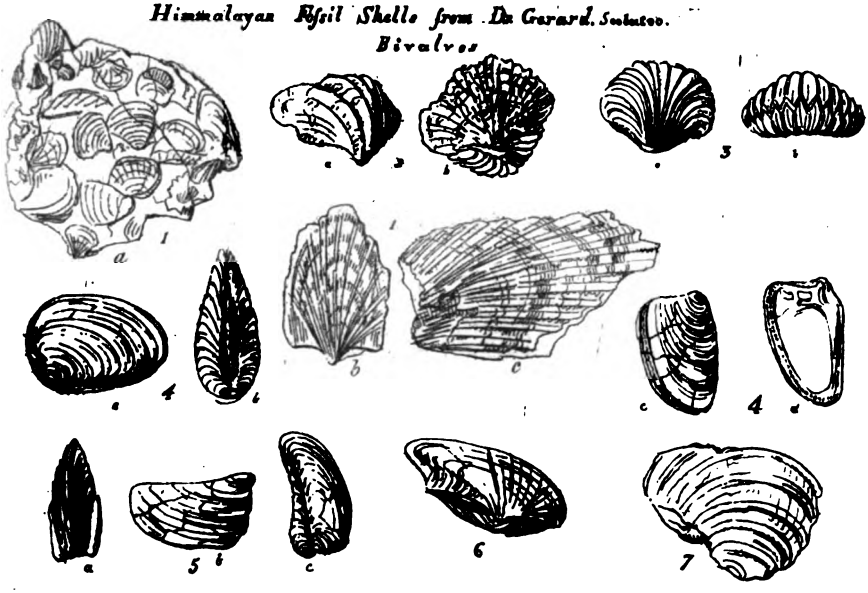
23. Detached *Orthoceratites*. This shell does not differ from the English one.

24. *Belemnites*, common and of all dimensions; the furrow is deeper than in most of the English specimens.

25. Fragment of the back of a testudinous animal.

Himmalayan Fossil Shells from Dr Gerard. Soloteo.

Bivalves



Univalves