XIII.

NOTICE

OF THE

OCCURRENCE OF GYPSUM

IN THE

INDO-GANGETIC TRACT OF MOUNTAINS.

By Capt. J. D. HERBERT, Sup. Min. Sur.

In the Wernerian arrangement of rocks, we find distinct places assigned to the titles of *Primitive*, *Transition*, and *Flœtz*, Gypsum, leading to the conclusion that this mineral is found, to some extent, in rocks of these several ages. Some geologists, however, appear to doubt the existence of Primitive or Primary Gypsum. Dr. Macculloch, in his "classification of rocks," hesitates to admit it. So does a writer in the 20th volume of the British Review, who yet adopts the Wernerian arrangement, as, in the main, conformable to observation. Professor Jameson states, that it has not been found in extensive masses in any primary rock. Professor Cleaveland admits its occurrence in the Alps, but it is most probable that he alludes to the fact mentioned by M. Humboldt in his "Gissement des Rochers," who states that at the Splugen pass, in the Alps, primitive gypsum

gypsum occurs mixed with dolomite, in beds subordinate to mica slate. With regard to Transition Gypsum, its occurrence is less questionable; but all authorities concur in fixing the principal and most important deposit of gypsum, to the newer red or saliferous sand-stone, (the red marle of England, and bunter sand-stein of Werner) or in its associated rock, the mountain lime-stone.

2. It was with these considerations in my view that I have always looked to the hills which bound on the south side, the several *dúns* or vallies that stretch along the foot of the great mountain tract, as the most probable locality in which to find this substance. They answer perfectly in character to the description given of the red marle of England. That they are really a type of the saliferous sand-stone, is proved by the occurrence of extensive deposits of rock salt in their prolongation towards the Indus.

3. The gypsum, however, of which I have the honor to submit specimens, is not found in those mountains, but in the clay-slate formation which bounds these vallies to the north, and which certainly possesses none of the characters of a secondary rock. It will be differently named by the followers of different systems; those who admit a transition class, will probably distinguish it by that term; while those who reject that class will, at once, call it primary: it possesses the characters of the transition clay-slate in its granular composition, in being associated with a fetid lime-stone, and in lying between the secondary and the better-defined primary strata. It is to be noted, however, that the gypsum occurs in very small quantity; it appears to me, indeed, certain, that whatever be the age of the including rock, the gypsum itself is of comparatively modern formation, and similar in its origin to those masses of stalagmitic lime-stone which are found in every rock, from the oldest gneiss to the

newest flœtz rocks, and that it is a merely local occurrence. This opinion I derive from the very limited quantity in which it is found, from its being associated with a sulphuretted lime-stone, and lastly, from its containing fragments of the neighbouring rock.

4. The principal deposit occurs in the bed of a stream which leaves the hills immediately below the village of *Nágal*, in the *Dehra Dún*— This strêam, so well known to visitors who come here from the *Haridwar* fair, as deriving its name from a spot called *Sansar Dhárá*,* or the dripping rock. This is a perpendicular bank of fifty feet in height, which, for a breadth of sixty or seventy feet, is faced with pendent stalactites, from which, and from the brow of the hill, descends a continual shower of drops. The water contains carbonate of lime in solution, (probably through the medium of carbonic acid) and is continually depositing it, so as to add to the number as well as size of the stalactites.

5. Two miles beyond this spot, at the confluence of another stream which comes from the left, the water of which is also charged with carbonate of lime, is seen the gypsum associated with a rock of rather an anomalous character. It has all the aspect of a lime-stone, but refuses to effervesce with acids, or at least does so very feebly. It is frequently of a deep black color and fetid odor, particularly when struck or fractured. The odor is that of sulphuretted hydrogen. As it passes into well characterised lime-stone, it must be considered, geologically, as one of the numerous types of that rock, though, as it is so highly charged with argillaceous, and probably siliceous matter, its claim to the title of a lime-stone would not be so obvious in a hard specimen, it is one of an extensive

* Or, according to some authorities, *Sastar Dhárá.*

extensive series of beds included in clay-slate which, as I have before observed, may be either transition or primary, according to the observer's views. Fragments of the clay-slate, as well as of the lime-stone, occur in the gypsum; the former rock is distinctly stratified, and dips east with an inclination varying from 30° to 50°; the lime-stone is not so generally stratified, or at least the stratification is often very obscure.

6. The gypsum is of the prismatoidal species of Professor Moh's, of the variety called foliated granular; it is of a snow-white color, the lustre is equal, or perhaps a little superior to that of white marble—It is scarcely translucent, or if so, only in a low degree. One small specimen which I saw was perfectly so, and had all the appearance of the most beautiful alabaster. The specific gravity I find to be 2.24, which is within the limits determined by Professor Moh; the hardness is about 2.0. In strictness, however, the hardness of a mineral cannot be determined from specimens in which the individuals are so small, at least not in the determinate manner required in the scientific system.

7. A second deposit had been discovered, about two miles up the bed of a stream which falls in opposite to *Sansar Dhárá*, by a gentleman who had visited the spot, and mentioned the occurrence to me. I was not successful, however, in my attempts to find it, although I met with a sufficient number of fragments to indicate the neighbourhood of some larger mass. The description given, with an examination of the specimens, enable me to decide that it was a small bed, or mass, in clay-slate. Some of the specimens had the slate adhering; it appeared evidently to have been formed by infiltration, or deposition from water, subsequently to the clay-slate, as the bed which, in its greatest extent, was nearly horizontal, had taken a downward direction, so as to fill up a perpendicular crevice in the slate. The gypsum exactly resembled that of the preceding locality.

Though

Though I could not find the principal bed, I detected a small mass of an irregular figure, enclosed in angular debris, which, from its impurity and the freshness of its surface, had been, I conclude, formed in that situation. The water of this stream is impregnated with sulphuretted hydrogen.

8. The third locality is on the ascent from the village of *Rájpúr*, immediately below the hamlet of *Jarí Páni*, situated in the range which rises to the north of the *Dún*. It has been found, as yet, only in veins, in a blue lime-stone, and chiefly of that variety called fibrous. Here, too, as at both the other localities, the rocks develope, on being fractured, a strong odor of sulphuretted hydrogen. How far this fact may be connected with the origin of the mineral in these places, remains to be determined.

9. The strong family resemblance which the lime-stone rocks bore in this place, to those in contact with the gypsum, at the former two localities, was sufficient warrant of the actual existence of the mineral, in greater quantity, in the immediate neighbourhood. And I was afterwards fortunate enough to discover it not many miles from the spot where these fragments had been picked up. This fourth locality is on the northern face of the range, in the ascent from the hamlet of *Ranon* to the summit. It is found in some quantity, and of the same character, and under precisely the same relations, as at *Sansar Dhárá*. The masses of which there are several, are all superficial, and contain fragments of the black fetid rock on which they lie, which also, like that at *Sansar Dhárá*, though non-effervescent itself, passes into one that is—and which also, when rubbed or struck, gives out the odor of sulphuretted hydrogen.

19. In

10. In the first volume of the new series of the Geological Transactions, a specimen of gypsum, as also of anhydrite, * is enumerated as amongst those presented to the Society by Mr. Colebrooke, in the name of Captain, then Lieut. Gerard. I have also heard of a specimen in a Calcutta collection, which had been presented by Dr. Govan. I am not aware of the locality of the latter; the former was found somewhere in the bed of the *Spíti* river, on the confines of *Ladák*, and at no great distance from a primary formation. No particulars are, however, given of the mode of its occurrence. These are the only instances of gypsum being found in these mountains, that I know of, besides those detailed in the present paper. Who was the first discoverer of the Dehra gypsum, I cannot say. I have been told that the substance had been familiar to the residents in the *Dún*, who confounded it with white marble, and that Captain Grant, of *Saháranpur*, was the first to suggest its real nature.

11. Gypsum is used as a material for statues, vases, columns, and similar works of art. The purer and more crystalline varieties, are even used for ornaments. When the water which it contains, and which amounts to twenty-two per cent. is driven off by burning, it forms the plaister of Paris, or material for stucco work, and for casts. It is also used (unburned) as a dressing for land, extensively, I believe, in America. The quality of the mountain gypsum is such as to fit it for all these purposes, except the second; but the quantity which has, as yet, been discovered, is not, perhaps, sufficient to render it an object of much attention. A careful search might be successful in laying open greater stores, though,

* I have in my possession a rolled piece of Anhydrite, presented to me by G. W. Traill, Esq. Commissioner; but I have mislaid the particulars of his note: it was, however, from the neighbourhood of the Snowy Peaks.

though, from what I have premised, there is little hope of finding any very extensive beds in the immediate vicinity of the present quarry.

List of Specimens forwarded by Dawk Banghy.

No. 1.—Is a specimen from the quarry, and will serve to give an idea of the best picked quality. (Art. 5.)

Nos. 2 and 3.—Are specimens of fragments from the bed of the stream. (Art. 7.)

Nos. 4 and 5.—Are specimens of the mass found in angular debris. (Art. 7.)

No. 6.—Contains imbedded fragments of associated rocks.

POSTSCRIPT.

Since first drawing up this paper, I have had access to one by M. BROCHANT, on the gypsum of the Alps, which it appears, till he undertook the examination of it, was considered to be a member of the primary class of formations. M. BROCHANT finds this opinion untenable; and from a large induction, he thinks himself entitled to conclude, that all the masses of gypsum in the Alps which he has examined, (and which he particularly remarks are superficial,) with whatever rocks associated, belong to one æra—an æra later than that of the newest of the rocks it accompanies. Now, in one of the lime-stones of this association, he has detected organic remains; so that if his conclusion of the cotemporaneous formation of these apparently unconnected masses be sound, they become, at once, referable to an æra posterior to that of primary formations. This so far confirms my view of the origin of Himalaya gypsum.

I ought

I ought to add, that, in mineralogical character, as far as that can be fixed by description, the gypsum of the Alps bears the closest resemblance to that of the Himalaya. Add to this, that they are, in both cases, found in superficial masses, which can hardly be called either beds or veins, that they are apparently independent and limited in extent.

XIV.