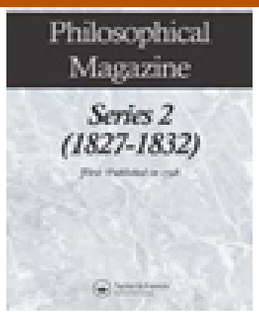

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XXXI. Collections in foreign geology.—[No. III.]

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been done, except in the case when the accelerating forces urging the particles are explicitly given.

The foregoing solution of the problem is essentially the same with that contained in my paper, Phil. Trans. 1824. M. Poisson has objected to my conditions of equilibrium in an article printed in the *Annales de Physique et de Chimie*, tom. xxvii. p. 225, which I have not examined till very lately, since the publication of his remarks in this Journal for July last. If his objections have not been noticed here, care has been taken to place the subject in such a point of view as to avoid their force. Of his arguments, when they are not chargeable with insufficient reasoning,—some do not apply to my theory, and some are not inconsistent with it. But the length of what I have written obliges me to postpone my further remarks on this subject to a future occasion.

Aug. 6, 1827. JAMES IVORY.

[To be continued.]

XXXI. *Collections in Foreign Geology.*—[No. III.] *By* H. T. DE LA BECHE, *Esq. F.R., L., and G.S. &c. &c.*

[Continued from page 109.]

9. *Introduction to the Mineral Geography of Sweden; by* M. Hisinger*.

THE Scandinavian Peninsula, extending from S.S.W. to N.N.E. from the southern point of Scania to Cape North, is cut into a multitude of gulfs (*Fiordar*) on its western side, and traversed by a long chain of mountains (*Fiellrygg*) from Lindesnæs in Norway to the Frozen Ocean, approaching nearer to the North Sea than the Baltic; so that its western side is very steep, whilst towards Sweden the land falls in a very gradual manner. The southern part of this chain is named Langfield; the middle portion Dovrefield. The latter obliquely cuts the Peninsula, and is prolonged to above lake Oresund, at the point where the Herjedal and Jemtland abut on Norway. The Scandinavian Alps may thus be divided into three or four portions, which are united in such a man-

* From a notice in Baron de Férussac's *Bulletin des Sciences*, for March 1826, of a German translation in Leonhard's *Zeitschrift für Mineralogie*.

For excellent descriptions of the primitive rocks of the northern part of our island, which (with similar rocks in Ireland) may be considered as the geological prolongation of the Scandinavian Peninsula, consult Dr. Macculloch's Western Islands, Classification of Rocks, and papers in the Geological Transactions. For those of the E. of Ireland, the memoir of Mr. Weaver, in the Geol. Transactions.—*Trans.*

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ner that each is prolonged below the point where it joins the other. The great breadth of the southern part of this chain is remarkable, extending from 8 to 10 leagues, the top of which is nearly flat. The passes rise for the greater part from 2000 to 3000 feet above the level of the sea. M. Hisinger mentions the exact height of many of these places, as well as of the summits which rise above this vast chain, the highest of which is 7100 feet. He afterwards enters into details relative to the position of the lakes, the direction of the rivers, and all that respects the exterior configuration and natural divisions of the country, and then proceeds to examine its geology.

Primitive Rocks.—The principal rocks, which as it were form the base of the Scandinavian mountains, are gneiss and granite. The former, that most commonly met with, is more solid than slaty; it is often granitoïdal, here and there passing into common gneiss and granite. That these two rocks are of contemporaneous formation in the North, is clearly seen by their alternation, and the frequent passages of one into the other, though gneiss occupies by far the greatest extent of country. Granite (properly so called) is nevertheless found in considerable abundance between Kautokeino in northern Lappmark, and the frontiers of Sweden, near the river Muonio, in the parishes of Nas, Jarna, Aeppelbo, and Yttamalung, in Dalecarlia; in some districts of Upland, Westmania, and Ostrogothia; on the coast of the Baltic, N. of Calmar, and on the road from Alhem to Wimerby and Ingatorp; and between Saby and Grenna, in the government of Jonkoping. Granite is seen, but much less developed, in the great chain of Scandinavian Alps, in the valley of Nea; below Sylfiell and Eckordorr; near Skarfan, in the pass of Skarfdorr; at the southern extremity of lake Wiggelg, on the confines of Sweden and the Herjedal. The gneiss often occurs with a well-characterized slaty structure, as in the environs of Stockholm and Trollhætta, but most frequently with a granitic structure, and then forms low *plateaux*, and low hills in the plains of Upland, Westmania, Ostrogothia, and Westrogothia. Among the minerals found in the gneiss, dark-green hornblende and garnet are the most commonly met with. A granatiferous gneiss of great beauty occurs near the town of Huddikswall. Small veins of quartz, felspar, granite, and compact trap, are occasionally observable in this formation. Black tourmaline and many other rare minerals are sometimes found in the granitic veins, as in the environs of Finbo, Fahlun, Ytterby, and Waxholm. Gadolinite and sphene are often disseminated in the gneiss.

The great variety of rocks subordinate to this formation in

the northern countries is remarkable. Besides mica slate, granular limestone, compact felspar, talcose and hornblende rocks, the gneiss contains the greater portion of the Swedish iron, copper, and argentiferous lead mines. It often passes into mica slate in the vicinity of these beds, the felspar suddenly ceasing, and being replaced by a greater quantity of mica, chlorite, hornblende, &c. The ores often occur in masses of considerable bulk.

Mica slate never occurs in the plains or low hills, except in beds subordinate to the gneiss; it commonly forms the most elevated summits of the great chain of Scandinavian Alps, and contains beds of metalliferous substances, limestone, &c. The other rocks, such as clayslate, limestone, talcose slate, compact felspar, and diorite, scarcely form any thing but subordinate beds in the gneiss or mica slate. Diorite and compact felspar alternate with gneiss in Smoland; talcose slate with micaslate in Jemtland; and with gneiss in the parishes of Hallefors and Grythytta, in Westmania. Dark-gray compact limestone is found in subordinate beds in the clayslate of Jemtland. On some of the Smoland heights, near the church of Saaby, and in the environs of Villkjol, a compact felspar occurs, containing small crystals of the same substance, thus forming a porphyry; it is however of inconsiderable extent.

Granular limestone is the most common and abundant rock of all those subordinate to the gneiss. As in the vicinity of the metalliferous situations, the gneiss sometimes passes into mica slate in those parts which approach the limestone; the latter is sometimes a pure carbonate of lime, at others it is mixed with the carbonates of manganese, iron, and magnesia. Among the numerous minerals disseminated in it, we may particularly distinguish spinelle in some beds in Sudermania; hornblende, sahlite, garnet and compact felspar are the substances which most commonly accompany the limestone. Galena, copper, and iron are sometimes found in it; as in the environs of Sahla, Tunaberg, Haakansboda, Langbanshytta, &c.

As far as respects the interior structure of the mountains, or the direction of the beds composing them, it may be stated in general terms that the direction of the beds is nearly parallel to the direction of the most elevated part of the great chain; thus in Sweden it is from N.N.E. to S.S.W. The dip of the beds is variable, and it is difficult to establish a rule in this respect; yet it would appear, that on the back of the mountains to the N. of Roras, the inclination is commonly towards the W. The angles of the dip vary somewhat less; and observation shows that the most horizontal beds generally occur on the highest summits, and those highest inclined, on the lowest

lowest parts of the mountains, and in the plains *. This nevertheless is subject to many exceptions.

Transition Rocks.—The transition rocks of Sweden are distinguished by their extent in an horizontal direction compared with their thickness, their position, and the nature of the fossils they contain. The rocks composing them are the following: graywacke, conglomerate, and quartzose sandstone; hornstone porphyry, and flinty slate; diorite both compact and porphyritic; a fine-grained and sometimes red-grayish sandstone, nearly without organic remains; aluminous slate; compact limestone, containing orthoceratites; and clayslate, containing fossils of the same genus, but smaller, named graptolites. A thick bed of greenstone occurs on the elevated summit of Mount Westgotha, above the four latter rocks; it is difficult to determine whether it belongs to the transition epoch, or is of volcanic origin.

The author afterwards describes with much care the different districts of Sweden in which transition rocks occur; viz. Dalecarlia, Jemtland, Nericia, Ostrogothia, Westrogothia, Kinnekulle, the Hunneberg and Halleberg, Mount Westgotha, the isle of Oeland, Scania, and the isle of Gottland.

Secondary Rocks.—The formations belonging to the secondary epoch are confined within the districts of Schonen and Scania. They are divided into two portions: sandstone and limestone. 1. Sandstone, containing beds of coal, bituminous slate, and schistose clay, occurs along the Sund, for the length of from three to four leagues, on the south of Kullaberg; its greatest breadth between the Sund and Süderas is more than a league and a half. The large-grained sandstone in the environs of Hoor, near the northern shore of lake Ringsjo, appears also to belong to the coal formation. 2. The limestones are of different kinds: Muschelkalk forms thick beds near the church of Ignaberga, at the foot of the Balsberg, near Christianstad, and in the environs of Carlshamn.

The limestone mixed with sand (greensand†) is developed in the countries of Svenstorp, Kopinge, Glamming, and Ingelstorp, in the districts of Ingelsta and Herresta, and to the E. of Istad. Beds of chalk, with nodules of flint alternating with a compact white limestone, are seen near Linhamn, on the Sund, to the S. of Malmo.

Basaltic Rocks.—These occur in Scania, at Holmestrand, in the southern part of Norway; at Mount Annekleſ, near Hoors; at the Gjelleberg, near the church of Rostanga. An amyg-

* This is a position of strata which deserves attention.—*Trans.*

† So it stands in the French text.—*Trans.*

daloid with a brown base, partly resembling that of Holmestrand, has been found in isolated fragments near the Sund, and it will probably be met with in place. There are greenstone dykes in Scania, and the country of Christiana in Norway. In the latter country they traverse transition limestone and clay slate; in Scania, they occur in the slate, and also in the sandstone and gneiss. Trap dykes are also seen in the environs of Rostanga, Konga, and Andrarum.

Alluvion Formations.—The base of all these in Sweden is composed of the remains of primitive rocks; and it is seen, from the nature and disposition of the rolled pebbles, that the cause which has given birth to these extensive formations acted from north to south. The presence of stones on the coast of Northern Germany, derived from Swedish rocks, yet more clearly proves this fact. The great catastrophe which has produced these numerous alluvions is the last which the Scandinavian peninsula has experienced*.

Bog iron-ore is met with in Smoland, Dalecarlia, and Jemtland; where it occurs in sufficient quantity to supply the wants of the principal forges of those countries.

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10. *On the Fresh-water Formation of the Environs of Rome; by* M. Alex. Brongniart†.

M. Omalius d'Halloy was the first geologist who referred the calcareous rocks so well known at Rome and Sienna, under the name of *travertin*, to the fresh-water formation; and who showed that, with the exception of fresh-water shells, which he did not find in the travertines of Tivoli, this limestone presents all the characters of minute structure, position, and mode of occurrence on the great scale, which belongs to the fresh-water formations, such as we have characterized them. They more particularly present those singular tortuous canals so constant in the fresh-water limestones of all countries, tubular cavities which had not escaped so excellent an observer as M. Von Buch, who had described them with perfect accuracy before he knew their importance as a general character of these formations.

The extent of this fresh-water formation of Southern Italy, its importance both as it relates to geology and the arts, authorizes me in entering into some details respecting its formation and position relatively to other rocks.

* This formation appears evidently to be the same with the Diluvium of British geologists.—*Trans.*

† Extracted from the *Desc. Géol. des Env. de Páris*, by MM. Cuvier and Brongniart.

M. Omalius

M. Omalius d'Halloy recognized these rocks at the entrance of the Pontine marshes near Cisterna, at the foot of the volcanic hills of Velletri, in a low plain. The limestone is white, compact, and solid, pierced by numerous tubular cavities, and contains *Limneæ* and globular *Helices;* he presumes that it is in many points covered, as in Auvergne, by volcanic breccias. It would appear that this limestone also occurs to the south towards Calabria; for it is stated that the temples of Pæstum, in the gulf of Salerno, are constructed with a concretionary stone, which is very certainly a travertine.

This formation appears at first as a trace at Monte Verde, S. of Rome, is afterwards found well-characterized in Rome itself, and then in considerable extent and thickness, at some distance from this city, towards the E. in the direction of Tivoli, and on the N.W. in the direction of Civita Vecchia: it was while examining these different points that I became acquainted with the various circumstances attending its position.

At Monte Verde it occurs only as a thin interrupted bed, deprived of its essential characters; it rests on a siliceous sand, mixed with some augite, which covers an earthy and very homogeneous volcanic tufa.

At Rome, M. Brocchi, with whom I had the great advantage of visiting these places, pointed out to me the fresh-water limestone at the eastern foot of the Aventin, on the banks of the Tiber, at the spot named the Cavern of Cacus; it is compact, contains some fresh-water shells, and rests on a red and earthy volcanic breccia: it is not covered by any rock.

The plain which extends from Rome to the mountains where Tivoli is situated, is in a great measure covered by a thick deposit of travertine, commencing at Martellone on the route from Rome to Tivoli, and being continued to the foot of the mountains of the latter place. This plain, in which the quarries of Ponte Lucano are situated, which furnish the travertine employed in building, may be considered, as M. Omalius d'Halloy has observed, as the bottom of a great lake, at present traversed by the Teverone, bordered by a volcanic breccia, and filled up and rendered nearly dry by calcareous deposits; for it is not entirely dried, and we may, with M. Omalius d'Halloy, consider the small lakes of Tartari, the Solfatara, &c. as the remains of this vast mass of water.

Geologists who have examined this formation, and especially MM. Von Buch and Omalius d'Halloy, have remarked; 1. That the lower and ancient travertine, the formation of which does not now take place, was that used for buildings, as alone presenting sufficient compactness and solidity; that at present formed

formed by the lakes of the Solfatara and Teverone not being sufficiently dense. 2. That fresh-water shells are very rare in it; for not only does M. Omalius d'Halloy mention that he had not seen any, but he considers that their absence is to be accounted for by sulphuretted hydrogen gas dissolved in these waters, and which prevents any fresh-water Mollusca from living in them. The very different state of the lakes Tartari and of the Solfatara accord very well with this theory.

The first contains limpid water, its banks are covered with calcareous incrustations possessing a crystalline structure; these are seen to be ancient, and it appeared to me that the present waters do not possess the property of depositing any: the bottom of this lake is covered with vegetables of various kinds, with Batrachian reptiles, insects, &c.

The lake of the Solfatara, situated nearer the foot of the hills, is altogether different: it is formed of a considerable mass of whitish water, perpetually disengaging bubbles of air, and a marked odour of sulphuretted hydrogen gas; the water deposits a thick bed of white compact limestone, a true travertine, on the vegetables which grow on its banks, and in the channel at which it escapes. When the bottom of this lake is agitated, a considerable disengagement of gas is produced; in the line through which the gas passes, the water acquires a limpidity, owing without doubt to the dissolution of the limestone by the carbonic acid disengaged. There is no living animal either on the shores of this lake or in its waters; at least we have never observed any.

The differences presented by these two lakes seem to be in relation to the differences often seen in the lower and upper parts of fresh-water formations; that of the Solfatara shows the formation of the limestone in activity. The waters are too highly charged with carbonic acid and earthy matters to allow animals to exist in it; consequently the first calcareous deposits should not contain any of their remains, at least in the vicinity of the spring: but in proportion as the mass of mineral matters diminishes, or in proportion as the channels are obstructed by these deposits, the waters become less charged with gas and lime, the deposit less rapid and less crystalline, the animals begin to appear, and this deposit charged with their remains would be above the first. This is probably the present state of the Lago de Tartari; and this relative position of the fresh-water formation without shells, and that with shells, is precisely that observable in all those places where these two rocks have been observed: thus, in the Paris basin, the siliceous limestone without shells occurs beneath the shelly millstone, &c.

These

These considerations have appeared to us of sufficient importance to arrest our attention for a short time, as they contribute to complete the history of a formation first recognized in the environs of Paris.

The travertine or fresh-water limestone of the plains of Tivoli is not, however, entirely without the remains of shells. I have observed them at Villa Adriana, at the foot of the hill, in a limestone bed, the position of which, relatively to the other rocks, is very clearly shown.

The fundamental rock of the Tivoli hills is a fine compact limestone, containing interrupted beds or nodules of chert, and which appeared to me to bear the greatest resemblance to the Jura limestone*; the fresh-water limestone sometimes rests immediately on this older rock, at others it occurs on a volcanic brecciola which rests on this compact limestone. The place last mentioned shows this superposition in the most evident manner. Proceeding from the surface downwards, we see: 1. a compact travertine, with tubular sinuosities and a few shells; 2. a mixture of friable travertine, and the debris of volcanic brecciola; 3. a thick bed of this brecciola.

The facts observed by M. Brocchi, which I have also verified with him, and those which I have myself noticed, establish the relative position of the rocks analogous to those of Paris, as well at Rome as in its environs; the following order of succession proceeding from the lowest to the highest.

1. A compact limestone, analogous to the Jura limestone*, or even, perhaps, to chalk. The fossils alone, when found, and they are very rare, can remove these doubts.

2. *Calcaire grossier*, composed at its base of blue, shelly, and argillaceous marl; and at its upper part, of reddish sandy limestone, and sometimes even of marine sandstone, as is clearly seen at Rome, at the foot of Monte della Grita.

3. Volcanic brecciola in all its modifications, covering the latter rock, as is well seen at Mount Marius.

4. The fresh-water formation. It would therefore be here in a different position from that which I have observed in the Cantal, in the department of the Puy de Dôme, and in that of the Allier. These may be referred to the middle or gypseous fresh-water formation, and those of the Roman states to the upper fresh-water formation, above the second marine formation; and this agrees still more perfectly with the position M. Prévost has assigned to the *calcaire grossier* of the Apennines.

I have already mentioned that there was a considerable

* Equivalent to the Oolite formation of the English series.—*Trans.*

quantity

quantity of fresh-water limestone or travertine on the side of Civita Vecchia. It is first seen constituting large platforms near Mala Grotta and Guido; it then ceases: but after having passed the Pulidoro and the hamlet of the same name, considerable masses of fresh-water limestone are traversed, forming salient portions, and appearing to advance towards the sea in the manner of a lava. It is thickest and most abundant at Monterone, where it rests on a rock having all the characters of a transition formation.

The celebrated cascades of Tivoli are not due to escarpments of the compact limestone, forming the mass of these hills, but to a stoppage of the valley produced by deposits from the waters which flow from it, and which were much more charged formerly than at present with carbonate of lime. The agitation of the waters gives rise to undulations in this deposit, not observable in the plain; and the less abundant precipitation allows the limestone to acquire a texture and crystalline aspect, removing it from travertine and rendering it more like alabaster. The same facts, owing to the same causes, are observable at the beautiful cascades of Terni. Compact fresh-water limestone or travertine is first met with in the environs and lower parts; and afterwards at Rieti, at the confluence of the Velino and the Nera, this little river precipitates itself over a bar of crystalline concretionary limestone, formed in the same way and on the same fundamental compact limestone as at Tivoli. M. d'Halloy has observed fresh-water shells in the concretionary limestone. H. T. D. B.

[To be continued.]

XXXII. *Reply to* Mr. Henderson's *Remarks on* Captain Sabine's *Pendulum Observations*. *By Capt.* E. Sabine, *R.A. F.R.S. &c.*

To the Editors of the Philosophical Magazine and Annals.

Gentlemen,

IN reply to Mr. Henderson's communication in your last Number, I beg to acquaint him that a detailed account of the corrections of my pendulum experiments was presented to the Royal Society the day after my return from the continent, and read the same week, being in the commencement of last June *; and that I expect it will be printed at the close of a paper containing a continuation of the same experiments connecting Paris and London, in which I have been lately engaged.

Mr. Henderson has justly characterized the correction of the

* See our last Number, p. 143.—Edit.

length