The difference existing between Flints and Coprolites is merely this: that in the one case the basis of animal matter combined with a gelatinous hydric calcic phosphate, and in the other with a gelatinous silicic acid. In both cases after combination the organic elements carbon, hydrogen, and nitrogen were slowly dissipated, while the *mineral* matter remained behind as we see it now.

The *source* from which the Coprolites seem to have derived their calcic phosphate is to be attributed directly or indirectly to the waste of the volcanic rocks of the Lammermuirs and of other Northern localities. Its *means of conveyance* the cold current which subsequently eroded the Gault, and brought down in solution the ferrous and other silicates to infiltrate the Foraminiferal casts.

Once more passing upwards in the Geological series to recent seas, we come upon what seem to be Coprolites even now in process of formation, for it is asserted by Prof. Edwards,[1] that a large part of the guano of the Chincha Islands in no way bears any resemblance to the excrement of birds, but, on the contrary, is a stratified deposit of Sponges and various Protists still in process of fossilization.

The anchors of ships weighed there are said to frequently bring up guano from the bottom of the ocean, and microscopic analysis has shown that the insoluble parts of the deposited guano consist of sponge skeletons, *Diatoms* and *Polycystinæ*, far too well preserved to allow us to conclude that they have passed first through the intestines of Molluscs, and then through those of Birds. However this may be—and one would not wish to put too much weight on these statements till they have been abundantly verified—we cannot but feel that the dignity of excrement has already been somewhat detracted from; and while on the one hand the sponges have recently received a great elevation in rank in the Zoological kingdom, they have on the other increased somewhat in importance in the Geological world.

NOTICES OF MEMOIRS.

I.—On the Geology of the Eastern Portion of European Turkey.

Die Geologischen Verhältnisse des östlichen Theiles der Europäischen Türkei. Von Professor Dr. Ferdinand von Hochstetter. 2^te^ Abtheil. Jahrbuch der K. K. geologischen Reichsanstalt, 1872. xxii. Bd. 4 Heft.

STRABO mentions as the principal mountain ranges of Roumelia the Bertiscus, Scardus, Orbelus, Scomius or Scombrus, the Rhodope, and the Haemus. He also asserts that these ranges reach in a straight line from the Adriatic to the Black Sea, which notion was until recently expounded in all the handbooks of geography, treating these ranges, as a central mountain ridge, and a continuation of the Eastern Alps. Only lately the discoveries of Boué, Viquesnel,

[1] Essex Inst., Salem, Mass., Bull. vol. i., p. 11, 1866. Ann. Lyc. Nat. Hist., New York, vol. x., p. 225, 1871. Quart. Journ. Micr. Soc., new ser. no. xlv., p. 71.

Grisebach, Lejean, von Hahn, and lastly von Hochstetter, disposed of this hypothesis. Grisebach proved that the Bertiscus corresponds with the Albanian Alps, the Scardus with the Schardagh of the present day. The Haemus is the Balkan, the Rhodope still bears the same name, and there is only the Orbelus and Scomius left: the former most probably corresponds with the highest western mountains of the Rhodope, with the Perim and Rilo Dagh; and the latter is the Vitos. The Vitos rises in the centre between the Balkan and Rilo mountains in the heart of Turkey. The mighty mass of syenite, of which it is composed, rises on a nearly circular basis from the plain of Sofia to an absolute height of 2300 metres. From this lofty mountain mass the four chief river-systems of European Turkey take their rise—the Marica, Struma, Isker, and the Morawa. Four mountain-systems also meet here, namely, the Balkan, the Rumelian Hills, the Rhodope, and the Upper Moesian Mountains. The Vitos may rightly be called a syenite massive, for the greatest portion of it is composed of this rock. On the south side of the Vitos, near Kovacevci, we only find syenite, which contains a considerable portion of magnetic iron-ore. The northern slopes of the mountain mass, towards Sofia, is almost solely composed of a fine-grained dark melaphyre-like rock, which is evidently connected in the east with the augite porphyries of the northern portion of the Brdo mountains, and in the west with the extensive igneous district of the Lülün and Visker mountains. The syenite of the Vitos is normal, sometimes coarse-grained, and contains, besides reddish orthoclase, a white triclinic felspar, and the hornblende varies in colour from black to green. Quartz, magnetic iron, titanite, and needles of apatite, with abundance of black mica, occur as accessory minerals. In the neighbourhood of Samakov, where the syenite is much decomposed, a rude iron industry has sprung up. The decomposed mass, which contains magnetic iron ore, is washed, and the latter mineral melted in furnaces of very primitive construction.

The plateau of Samakov (960 metres) is separated from the valley of Dubnica (940 metres) and Radomir (618 metres) by ranges of hills, which are chiefly composed of old crystalline rocks, which connect the Rilo mountains with the Vitos. The principal rock of this range is coarsely fibrous grey gneiss, which often assumes a porphyritic texture, containing large lumps and crystals of felspar. Granite dykes and veins are frequently met with, and alter sometimes into a black micaceous hornblende rock and into granular amphibolite.

West and south-west of the Vitos, Hochstetter discovered a system of stratified rocks, which repose on the crystalline base, and stretch towards Dubnica and Radomir in a north and north-westerly direction, most probably as far as the valley of the Nisava, which river divides these rocks from the corresponding ones on the other side of the valley, which belongs to the Balkan range. Hochstetter was able to distinguish three distinct systems of strata in this district. At places, where the crystalline basis is exposed, we find resting directly on it (*a*) a system of more or less great thickness of red and

white quartzose sandstones, and in close connexion with it variegated friable marly shales, alternating with white and brown sandstone beds, and with a few layers of limestone and dolomite. Resting unconformably on this is (*b*) a system of grey and white, rarely reddish, dense limestones and dolomites of enormous thickness, which at once remind one of the character of the limestone Alps. This formation composes the Golo Brdo Mountains, the Koniavo, and Vrbina Planina. The Struma river has broken through this range (12 to 1500 metres) near Köstendil. Beyond this defile this system of rocks extend farther north in the direction of Trn and beyond.

Placed in comparison with the limestone series of the Alps, the lower marl and sandstone series would, perhaps, represent Lower Trias (Werfener Schiefer), partly even the Permian (Rothliegendes), whilst the upper portion of it would correspond with the Middle and Upper Trias. But more probably (and a few although indistinct fossil remains corroborate it) this system of rocks should be compared with the northern Carpathians; in this case the quartzite, sandstones, and marls would represent the Keuper, the beds and limestones above Kossen beds (*Avicula contorta* zone), whilst the principal mass of limestone and dolomite would belong to the Jurassic and Cretaceous series. The range of a third system (*c*) is less doubtful, in the valleys and extending far on the north-eastern and eastern slopes of the Koniavo, the Vrbina Planina and northwards reposes unconformably on the limestone beds a system of strata of great thickness, which is composed of greyish-brown shaly sandstones and alternating clayey marls. Sometimes limestones are found with this series. The general aspect of the low hilly country formed by these beds much resembles the character of the Gosau formation of the Alps, or of the Carpathian sandstones, and no doubt they belong to the Cretaceous series, most likely to the Gault, which is well developed in the Balkan. Fossils were obtained only in two places, in the Bunovo Valley and near Trn, amongst them *Ammonites mammillatus*, Schloth., a true Gault species.

Analogous to the eruptive district lying between Burgas and Tamboli, described in the first part of this paper (reviewed in Geol. Mag., 1871, Vol. VIII., p. 466), the igneous rocks of the Lülün and the Vitos are also basic rocks of the character of melaphyres, augite porphyries, and augitic oligoclase or labrador porphyries, which are accompanied by widely-spread stratified tuffs, conglomerates, and amygdaloids. West of the Vitos, and inclosed by it and the Lülün and Visk mountains, lies a small Tertiary basin, in which is deposited a bed of Brown coal, which is exposed at several places.

Between Vranja and Leskowac, the Morawa high crystalline mountain ranges (2000 metres) rise up, which in S.E. are connected with the Rhodope, and in S. with the Schardagh and Pindus systems. These ranges consist of gneiss, mica schists, and old clayslate. Numerous rhyolite and trachyte eruptions in connexion with much tuff forms another important character of this district. Professor Hochstetter gives in his valuable paper, not less than in the first part of it (1871), a detailed description of his many tours

and excursions over the country with accompanying sections and a new geological map, the basis of which is entirely new and compiled by him from the surveys of Austrian officers, the engineers of the Ottoman railroads, and himself. He also appends a valuable list of heights in the Eastern portion of European Turkey.

C. L. GRIESBACH.

II.—On the Glacial and Champlain Eras in New England.

By J. D. DANA.[1]

DR. DANA'S observations go to show that the Glacial period was an era of transportation by ice, with the deposition from the glacier of only a small part of the drift, including the Boulder-clay; while the early part of the Champlain period, to which he refers the time of melting, was an era eminently of deposition, and also of further transportation by moving waters and floating ice. He regards the Glacial period as of great duration, and expresses the opinion that one foot a week was the average rate of the movement of the ice, so that 10,000 years would be required to carry a boulder one hundred miles.

The general course of the movement over New England was to the south-east. In the northern part of this country he estimates the ice to have had a thickness of from 5,000 to 6,500 feet, and in the southern part an average of 2,700 feet. The pressure must have been immense—6,000 feet corresponding to at least 300,000 pounds to the square foot. Under this great pressure there was not only abrasion of the rocks beneath by the ice armed with stones in its lower surface, and also a crushing of softer kinds from mere pressure, but, besides, a breaking and crushing of the ice itself against the obstacles in its course, and also a pressing of the plastic material down among all the stones and gravel or sand; and thus it was able to envelop and take up into its mass the loose material. Further, the ice of the ice-mass above must have been forced down into all openings and crevices in the rocks, so that the glacier, as it moved, had tremendous power in abrading, and must have made boulders and gravel in immense quantities.

The valleys of New England have throughout a high terrace along their sides, of material generally stratified, which belongs to the Champlain formation, being merely the old alluvial deposits of this era terraced in consequence of a general rising of the land, when what he has called the Terrace or Recent epoch began. He is of opinion that in the Quaternary period of North America over the higher latitudes, there was an upward movement for the Glacial era, a downward movement below the present level for the Champlain era, and an upward one for the Terrace era.

[1] Reprinted from the "American Journal of Science and Arts," vol. v., March, 1873.