(1822), p. 120, used the term Weald Clay, confounding with it the Galt.

B. Smith had confounded this with Kimmeridge Clay, and had mapped both as "Oaktree Clay." Webster had grouped with "Ferruginous Sand."

C. Nil.

HASTINGS SANDS. A. (*a*) Fitton. (*b*) 1824. (*c*) Ann. Phil., vol. viii., n.s., p. 373. (*d*) Hastings Sands. (*e*) Named because at Hastings "the strata are well developed and conspicuous," p. 377.

B. The formation had been grouped with "Ferruginous Sand" by Webster, with the "Iron Sand" by Conybeare and Phillips, and as they remark at p. 136, "It is not possible to assign the synonyme employed in the geological works of Mr. Smith."

C. The subdivisions of the Hastings Sands into "Horsham Stone," "Tunbridge Wells Sand," "Cuckfield Clay," "Grinstead Clay," "Wadhurst Clay," "Ashdown Sand," "Ashburnham Beds," were made by Messrs. Bristow and C. Le Neve Foster in the Geol. Survey maps, published 1864.

WEALDEN, as a group name, was first proposed by Mr. Martin in his "Memoir on a Part of Western Sussex," 1828, and adopted by Fitton in a paper *read in* 1827!! Trans. Geol. Soc., ser. 2, vol. iv., p. 103.

NOTICES OF MEMOIRS.

I.—On the Metals and Minerals of Upper Burmah. By Capt. G. A. Strover, Political Agent, Mandalay.

[Published by order of the Government of India; Department of Agriculture, Revenue, and Commerce.]

THE Chief Commissioner having called for a report upon certain mineral products of this country, it has occurred to me that as many years have elapsed since any concise information has been given upon the subject of metals and minerals generally, and as our knowledge regarding these products has been greatly extended of late in consequence of increased intercourse between the British and Burmese Governments and the subjects of each nation, it will not be out of place, and of some interest, to give a brief sketch of the resources of Upper Burmah as regards the same.

Gold.—It has been generally supposed that Upper Burmah is not rich in itself as regards this metal, but there would seem to be good grounds for supposing that it exists very extensively. In former years the gold used in the country was imported from China to the extent of some 400 or 500 viss annually, but the imports have considerably decreased since the commencement of the Mahomedan rebellion in Yunan, and now do not exceed 200 viss per annum, the deficiency being imported from Rangoon. It is an article that is greatly used in the decorative art, and appears to be generally plentiful.

In the Mogoung district there would seem to be a gold-field that, if properly worked, would prove very productive. Some years ago, a Mr. Golding, of Australian experience, contracted with the King to work one square mile of this field for a sum of Rs. 25,000 annually, for ten years, but unfortunately the district proved to be malarious and Mr. Golding succumbed to fever; he, however, pronounced the fields to be equal to any in Australia, if not better. I am not aware that he succeeded in procuring much gold. Since then no attempt has been made on the part of the Burmese Government to work the mines.

To the north-east of Mandalay, in the Shan States, there is another field of gold. My information tends to show that here again, with energy and enterprise, considerable quantities of gold could be extracted, and the mines prove very productive; but the locality at present is malarious, and but little gold is procured.

At Thayet-pein-yua, near the Myit-Nyay, on the road to Pyoungshoo, to the south-east of Mandalay, the gold quartz is found in abundance, the reefs cropping up from the ground, and there is reason to believe that very valuable gold-mines are in existence, and could be worked and developed with little trouble. A Shan lately procured from here a piece of quartz 3½ lbs. in weight that produced exactly 2½ ticals of gold.

In the Yaw district, to the south-west of Mandalay, gold is obtained in fair quantities in the alluvial deposits; it exists at Sagaing, Kannee, Sein-joo, and is also obtained from the Kyeend-ween river, and, indeed, it is procurable from the sands of most of the streams between Mandalay and Mogoung. The natural conclusion from this profusion of gold in the rivers and streams of Upper Burmah is that it exists in large quantities *in situ* somewhere, and, as I have explained, this is the case, and doubtless there are more deposits that have not been discovered.

Silver is found in many localities in the Shan States to the east of the Irrawaddy river, but the most prolific mines are those situated at Bawyine, Kyouktch and Toung-byne, near Theebaw, to the north-east of Mandalay. It is mixed with lead, and is in fact a rich argentiferous galena. One mine, the Kampanee, will yield as much as 40 ticals of silver and 25 viss of lead from one basket of the ore, while the poorest mine gives 4 ticals of silver and 30 viss of lead. Other mines exist, such as the Baudween, Baudweengyee and Sagaing. The metal is also found in other towns unmixed with lead. The supply of silver obtained hitherto has been sufficient for the requirements of the country in conjunction with the imports from Yunan.

Copper.—This metal is found in the Shan States, but is not worked. It is also found at Kolen-myo and Sagaing; at Bawyine and Kolen-myo the malachite appears to be of a rich description. The copper resources of the Shan States do not appear to have been ever utilized to any extent, and the deposits, which seem to be abundant, remain as nature placed them. The Sagaing mines were worked in former times by Chinese, but many years have elapsed now since they were

abandoned. The surface ore is not promising. Most of the copper used in Upper Burmah is imported from China. It is plentiful in the Province of Yunan.

Iron.—Iron abounds in the Shan States, and the district of Pagan, to the south of Mandalay, is noted for it. A manufactory exists on a rough and ready scale in this district at Pohpah Toung, but the outturn is inconsiderable. To the west of Sagaing, for miles up the Irrawaddy river, the ore abounds—a rich hæmatite. His Majesty is now procuring iron works from England, and will before long have a large foundry, with all the requisite machinery, erected and at work at Sagaing. The surface hæmatite alone will feed it for years to come, if worked.

Two mining engineers are now awaiting the arrival of the works, and expect to proceed to Sagaing soon to commence operations.

Lead is found in abundance in the Shan States, and is extracted from galena. Considerable quantities of this metal could be obtained if such was desired. At present moderate supplies are procured, sufficient for the requirements of the land. It is also imported from Yunan.

Tin.—This metal exists in the Shan States to the south-east of Mandalay, but the mines have never been worked. The tin consumed in the country now is all imported.

Platinum is said to exist in the Shan States, and it seems probable that it does exist, but I have no reliable information on this point.

Graphite is found to the east of Nat-taik in large quantities on a low range of hills near the village Nyoke-toke. It is not utilized.

Coal.—This mineral is known to exist at Thingadaw, about 70 miles above Mandalay, on the western bank of the Irrawaddy; at Shuaygoo below Bhamo; at Meimbaloung in the Shan States east of Mandalay; to the south-west of Mandalay in the Yaw district, at Yaignaw, east of Nat-taik. It is found at Pagan and Shimpagah, and it is probable that it exists near Meuhla and Yeynangyoung. At Thingadaw the coal has been extracted, but it is of an inferior description and more resembles lignite than true mineral coal. An attempt was lately made here to ascertain the productiveness of the coal-beds. It is nearly certain that plenty of coal exists in the locality, and a few more borings would probably prove this. The coal-bed in the Shan States at Meimbaloung contains true mineral coal, and consequently a valuable coal. It has been inspected by an experienced mining engineer, and highly approved of as equal to the best English coal. There is little doubt that the beds are extensive, but unfortunately the distance inland is great, and no easy means are available for transporting the coal to the low lands; indeed, the only method at present is by floating it down mountain streams and rapids on rafts, which entails considerable risk and loss of coal. European skill and enterprise would soon make a safe route of one description or another if really required by the Government; it remains at present, with neighbouring wealth, where nature placed it, awaiting development in times to come.

Jade and Amber.—The quality and extent of these mines above

Mogoung is well known. They are both extensive and capable of development.

Sulphur.—This substance is not found in mass or in its native state in Upper Burmah, *sui generis*, but is found in efflorescent salts, and is manufactured from metallic sulphurets. The following is a list of localities where it is made, and the yearly average outturn :—

Mooda Myo, N.	3,000 Viss.*
Tsein-goon, E.S.E....	2,000 ,,
Kyouk-hoo, S.E.	3,000 ,,
Bawyine, Shan States, S.E.	6,000 ,,
Dybayen Myo, N.W.	4,000 ,,
Pagan Myo, west bank of the Irrawaddy	4,000 ,,
Toungthoo Einlay, E.S.E.	4,000 ,,
From the Bhamo District	2,000 ,,
Total Viss Yearly	28,000 = 39 tons 1¼ cwt.

At Toungthoo Einlay, to the south-east of Mandalay, sulphur is manufactured by the Toungthoo Shans, who sell their outturn to the King; at all the other places the mines are worked by His Majesty.

The Bawyine works have been increased during the past month by four extra furnaces, which will give about 5,000 viss more per annum. Sulphur appears to abound in the Shan States; in fact, at Bawyine, Kyouktah, Dybayen, Pagan, and Toungthoo Einlay the supply seems to be unlimited. It is found in the Tertiary blue clay from 12 to 20 feet below the surface, which is an alluvial deposit above the Old Red Sandstone; it is embedded in the clay, and consists of very hard metallic pyrites of some size.

The mode of extracting the sulphur is very simple. Common chatty-shaped vessels are made on the spot from the soft blue clay in which the ore is found. The larger vessel is filled with broken ore and placed on a fire, a clay retort being filled to the top, and communicating with the smaller vessel. The sulphur is thus sublimed and condensed, after which the retort is broken and a hollow tube of flower of sulphur extracted therefrom which is superior to that condensed in the vessel. Iron pyrites do not appear to be utilized in the manufacture of sulphur, and it is doubtful whether the Burmese could utilize it. Pyrites are to be found in abundance in parts of Upper Burmah and the Shan States. The imports from Yunan are also considerable every year.

It is manufactured in Yunan, and in the Shit-Pyee-Doung, or eight Shan States to the north-east of Bhamo, at present under the rule of the Chinese, or tantamount to the same. European sulphur can be purchased in the bazars at the rate of Rs. 3 per viss.

Saltpetre is manufactured at the following places in Upper Burmah :—Toungthoo Einlay, Ameerapoora, Shimpagah, Ong-ben-lay, Leen-gine, Sameet-koon, Pyogan, Aung-gyeen, Samoon-gyee, Oo-yun-galay, Shuaybo, Satoung-ma, Salem-myo, Yoon-doo, Myo-tha, Tsit-kine, Aloon, Tee-ber-Yeen, Myay-Yeen, Shin-bin-oon-Eni, Yua-

* 8 Viss are equal to 1 Maund or 25 lbs. avoirdupoise.

shit-gyee, Enidyne Yua (Kyouksay, S.E.), East of Pagan (Yoongdaw Toung).

The yearly average outturn is about 40,000 viss. The manufacture is not prohibited as with sulphur, and considerable quantities are used in the preparation of fireworks.

The manufactures at Toungthoo Einlay, Eindyne, Kyouksay, Yoongdaw Toung, and Sameet-koon can produce very largely if required.

At Toungthoo Einlay the Toungthoo Shans in former times used to make from 20 to 25,000 viss of saltpetre per annum, but emigration to British territory has considerably reduced this.

The price of saltpetre is Rs. 50 per 100 viss. Many parts of Upper Burmah are well suited for its manufacture, the ground being well supplied with nitre.

Rubies, Sapphires, Garnets, etc.—These are found in abundance at Mogouk, Kyat-pyeen, to the north-east of Mandalay near Momeit. The ruby ground extends over a large area of hilly country. The gem sand is found from 3 to 15 feet below the surface soil, and the beds are then followed up. The method of working is primitive and rough, the consequence being that large rubies are seldom extracted intact.

Some years ago, a Mr. Bredamajee, a German Mineralogist, was located at these mines for the purpose of developing them, but, after a short stay, he got into trouble with the people, and was dismissed. He declared that, with careful working, rubies as large as pigeons' eggs could be extracted, and that the mines were very rich. At Mogoung also ruby mines exist, and very fair rubies have been found. The Sagyeen or marble hills, a short distance to the north of Mandalay, contain the gems as well, but they are of too light a colour to be valuable. They are, however, mixed with other rubies and disposed of.

Salt.—Extensive salt-fields exist at Shimpagah, a short distance above Mandalay, on the western bank of the Irrawaddy river. It is also obtained at other places in Upper Burmah on a small scale. Large quantities can be manufactured at Shimpagah, but imported salt is fast taking its place in the market. The hill people, though, appreciate to a certain extent the Shimpagah salt and mix it with European salt.

Petroleum.—This mineral oil is found at Yeynangyoung and Pagan, but information regarding it is so complete that it is hardly necessary to allude to it further. I will, however, make a few brief remarks.

There are at present about 150 wells worked at Yeynangyoung; the quantity of oil estimated as deliverable from these wells is 15,000 viss daily, of which 10,000 viss is taken by the contractor who supplies British Burmah, and 5,000 viss by the contractor who supplies Upper Burmah. The total yield of these wells is 6,000,000 viss per annum, or 9,375 tons. There are many abandoned wells, and wells that produce very small quantities of oil. At Pagan there are about 50 wells: they yield daily 1,500 viss of oil, which the earth-oil contractors, at present the Lay-myo-woon and one Moung

Tsanwah, are allowed to purchase. The oil from these wells is obtained in a more liquid state and more resembles naphtha. It is of a brackish nature, and is better suited for lighting purposes than the Yeynangyoung oil. The total supply of earth-oil in Upper Burmah now per annum is 66,000,000 viss or 10,312½ tons.

I have omitted to mention marble and limestone, but both abound.

Upper Burmah, with its metals and minerals, its forests, natural resources, productiveness of soil, and from its geographical position, situated as it is close to the teeming population of the Chinese empire, ought to be the richest country in Asia, and Rangoon one of the largest emporiums of trade. The productiveness of the soil, as regards cereals and other crops, is wonderful. The indigo plant, which is prolific in its growth, gives three crops per annum, and the dye would quite equal that of Bengal with careful and proper treatment in its manufacture. Paddy, wheat, cotton, cutch, grain, sesamum, sugar-cane, tobacco, tea, coffee, each has its own soil in abundance. Teak and other useful trees abound.

II.—M. Hébert's Zones in the Chalk.

THE general similarity of mineral character of the Chalk formation in England, and the habit of not carefully recognizing the different horizons from which fossils have been obtained, have to some extent militated against the further subdivision of the Chalk than that usually adopted in this country, viz. Upper White Chalk with flints, Lower Chalk without flints, and Chalk Marl. Lately some attention has been drawn to this subject, in papers read before the Geologists' Association by Mr. Caleb Evans 1870, Mr. Bedwell 1873, and Mr. Dowker 1869; also by Mr. Whitaker.

In France, however, for many years past, M. Hébert has specially studied the Chalk of the Paris basin, and communicated the results in sundry papers to the Geological Society of France, and which are published in the *Bulletin* for 1862, 1863, 1866, 1872, etc.[1] M. Hébert considers that the divisions are so clear that it is even possible to assign precisely where one ends, and the other begins; not only from the change of the fauna, but also from the general petrographic character. Besides, the superior surface of one division is always indurated and perforated to a greater or less extent, as is especially well shown at Meudon, where the White Chalk is seen in contact with the Superior Chalk or Pisolitic Limestone. From his researches M. Hébert has established the following subdivisions in ascending order:—1, La Craie glauconieuse; 2, La Craie marneuse à *Inoceramus labiatus;* 3, La Craie dur à *Holaster planus*; 4, La Craie à *Micraster cortestudinarium;* 5, La Craie à *Micraster coranguinum;* 6, La Craie à *Belemnitella quadrata* et *B. mucronata;* 7, La Craie supérieure (calcaire pisolitique). In general the

[1] M. Hébert communicated his views also to the British Association, Brighton, 1872, on the divisions of the Chalk of France, and paralleled them with those of the English Chalk, as seen from Folkestone, to St. Margaret-on-Cliff, Dover (see Reports, p. 104). See also M. Hébert's Classification in Geol. Mag. 1869, Vol. VI. p. 200. Also MM. Cornet and Briart, on Belgian Chalk, Geol. Mag. 1872, Vol. IX. p. 469. —J. M.

lines of discontinuity correspond to gaps often considerable; thus between the Glauconitic Chalk (1) and Marly Chalk (2) there is wanting, in the north and east of the Paris basin, the green sands of the Maine, which have a great thickness in Touraine and le Perche, but which thin out to the east before reaching the Seine, and which are represented in the south by the *calcaire à Ichthyosaurolites*. Again, between the Marly Chalk (2) and the Chalk with *Holaster planus* (3), there are wanting the great beds of Hippurite Limestone, which form so important a feature in Southern Europe, and which, from the abundance of *Hippurites*, *Radiolites*, *Sphærulites*, and allied genera, and the comparative absence of *Ammonites* and allied forms, readily differentiate the Cretaceous era of Southern from that of Northern Europe. The zone of *Micraster coranguinum* (5) forms two series; the lower, well developed in the western, seems to be wanting throughout the eastern part of the Paris basin,[1] whilst the Chalk with *Belemnites mucronata* is absent in the sections exposed along the coast. These lacunæ afford a proof to some extent, according to M. Hébert, that the Parisian basin had already emerged during the deposition elsewhere of the missing strata, while at the same time it explains the presence and origin of the hardened surfaces during emersion and their perforation by atmospheric agencies. J. M.

III.—On Foraminifera from the Tertiaries of San Fernando, Trinidad.[2] By R. J. Lechmere Guppy, F.L.S., F.G.S., etc.

In July, 1863, I brought under the notice of the Scientific Association the nature of the Asphalt Rock figured at page 38 of the Geological Report on Trinidad. I then stated that I had discovered that that rock consisted principally of the shells of *Orbitoides* and *Nummulina*, two genera of Foraminifera characteristic of Older and Middle Tertiary strata. In the interval between the reading and the printing of the paper in which my discovery was communicated to the Association, the same species of Foraminifera had been detected in the Miocene rocks of Jamaica, as noticed in a postscript to my paper. Previously however to this a few species of Foraminifera had been recorded from the Tertiaries of Haiti. The names of all these species will be found in my paper on the Tertiary Fossils of the West Indies, printed in the Proceedings of the Scientific Association, 1867, page 145.

Owing to the nature of the cliffs at San Fernando, great part of their face is often concealed for many years by earth fallen from the top, but occasionally the loose and disintegrated material is removed so as to expose the solid rock. This has happened lately to such an extent as to expose a large series of beds of which I had never previously been able to get a fair sight. These beds lie (in geological language) just above the Nucula-rock, which I have already described at pages 46 and 82 of the Proceedings for 1866 and 1867, and also in the Geological Magazine, Vol. IV., p. 497. The mineral com-

[1] Bull. Soc. Geol., 2 ser., t. 29, p. 446, pl. iv.

[2] From the Proceedings of the Scientific Association of Trinidad. December, 1872.

position of these beds is argillaceous, with a large proportion of calcareous matter. Their colour is of a light greenish-grey, and the effect of weathering upon the matter is to develope a sort of spheroidal concretionary structure entirely independent of the original bedding and lamination. This spheroidal structure is probably partly or wholly induced by meteoric action. The beds are an upward continuation of the Nucula-bed, being similar in composition, and are part of the strata numbered 11 to 17 in the section given in my paper in the Journal of the Geological Society, vol. xxii., p. 571; and I propose to term them the Nodosaria-beds. They rarely contain any molluscan remains, but are stored abundantly with Foraminifera characteristic of deep water. I append a list of the forms I have been able to determine, including those of the Asphalt-bed. These determinations are only approximate, and the geologist will not expect from me a very exact statement of the varietal or subvarietal names of the forms, which can scarcely be given except by those who, like Messrs. Parker and Rupert Jones, have devoted great attention and study to these minute but beautiful shells. I trust, however, to place the material in the hands of those able to do more justice to the subject, and I only intend the present communication as a record and announcement of the discovery. So far as I am able to judge from the Foraminifera now discovered, the facts appear to lend a further support to my view that the Nucula-beds of Barbadoes and Trinidad were deposited in moderately deep water. The depth of water seems to have increased after the deposition of the Nucula-beds, as seems to be evinced by the Nodosaria-beds of Trinidad and the Polycystina-beds of Barbadoes.

List of Foraminifera from the Lower Miocene strata of San Fernando, Trinidad.

Nummulina ramond, Defr. var.*	*Nodosaria pyrula*, Orb.
Orbitoides Mantelli, Norton*	*Dentalina elegans*, Orb.
Amphistegina vulgaris, Orb.*	——— *filiformis*, Orb.
Spiroloculina nitida, Orb.	——— *communis*, Orb.
Glandulina lævigata, Orb.	*Orbulina universa*, Orb.
Nodosaria glabra, Orb.	*Globigerina bulloides*, Orb.
——— *hispida*, Orb.	*Polymorphina gibba*, Orb.
——— *raphanistrum*, Linn	*Rotalia orbicularis*, Orb.
——— *ovicula*, Orb.	——— *corallinarum*, Orb.

* These three species are only found in the Asphalt-bed and gypseous Marls.

Several other forms have not been satisfactorily determined.

IV.—Geological Survey of Canada. Report of Progress for 1871-72. By A. R. C. Selwyn, Director. (Montreal, 1872.)

THE progress of the Geological Survey ought to be very satisfactory to the Government of Canada, so ably and effectively has it been carried on for many years by Sir W. E. Logan, F.R.S., and for the last three years by the present Director, Mr. Alfred Selwyn, F.G.S. Since the first publication of the Reports in 1843, they have steadily and annually continued, and, together with other special reports, descriptions of organic remains, a great geological map of the Dominion of Canada, and many smaller maps and sections,

comprise a vast and important amount of geological, mineralogical, and palæontological information, highly creditable to the Governments who supported it, and to Sir W. Logan and the staff who so efficiently have carried on the work.

The special reports contain papers chiefly by Dr. Sterry Hunt; one on the Geology of Newfoundland, by Mr. Murray; another on the Silurian Fossils of Anticosti, by Mr. Billings; at the same time during the progress of the Survey, the Canadian organic remains have been carefully illustrated, in four decades, the descriptions being furnished by Messrs. E. Billings, J. W. Salter, Prof. R. Jones, and Prof. Hall, besides the first volume of Silurian Fossils by Mr. Billings, and the fossil plants of the Devonian and Upper Silurian of Canada by Dr. J. W. Dawson, to be followed by others in preparation.

In the volume for 1871-72, besides the summary reports of the Director, Mr. Selwyn contributes the Journal and Report of preliminary explorations in British Columbia, assisted by Mr. Richardson, from which it appears the rock formations may be grouped under the following divisions in descending order, although the comparative absence of fossils renders their classification difficult, —1. Superficial deposits; 2. Volcanic series and coal and lignite of Main-land; 3. Jackass mountain conglomerate group; 4. Upper Cache creek group; 5. Lower Cache creek group: the fossils indicate a horizon between the base of the Devonian and the summit of the Permian; 6. Anderson River and Boston Bar group; 7. Cascade mountain and Vancouver Island crystalline series; 8. Granite, Gneiss, and Mica-schist series. The next report is on the Coal-fields of the east coast of Vancouver Island by Mr. Richardson, with a map of their distribution, and a note on the fossil plants by Dr. Dawson, and the Analysis of the Coals and Rocks by Dr. Sterry Hunt. Coal is found to some extent in the island, and the seams vary in thickness from four to seven feet, or even more, and vary in quality. The plants associated with the coal at Nanaino and North Saanich belong to a flora which has occasioned some controversy. "It was originally," says Dr. Dawson, "described by Lesquereux and Heer as Tertiary, being indeed very nearly allied to the Miocene of Europe." Newberry, however, on the evidence of the associated marine fossils, and on the analogy of the Cretaceous flora of Nebraska, regards it as of the latter age, and this is, I believe, the view more generally adopted.

The remaining reports in this volume are of the country between Lake Superior and Albany River, by Mr. R. Bell; the country between Lake St. John and Lake Mistassini, by Mr. W. McOuat; Surveys in the Counties of Leeds, Frontenac, and Lanark, in the Province of Ontario, showing the position of the worked gold-mines, and the course of the auriferous zone, by Mr. H. G. Vennor; on Geological Investigations in New Brunswick, by Prof. L. W. Bailey; and a Summary of the Statistics of Mines and Mineral Produce of the Dominion, by Mr. C. Robb.
