the Amber fauna, there can be little doubt that it belongs to the Tertiary epoch.

We close with a few statements relative to the eighty-seven species mentioned in the previous pages. Six of them are from the Devonian Formation; fifteen from the Carboniferous; one from the Trias; and sixty-five from the Tertiaries. Ten are *Coleoptera*: viz., one from the Trias and nine from the Tertiaries; four are *Orthoptera*, all from the Carboniferous; nine are *Neuroptera*, viz., six from the Devonian and three from the Carboniferous. Five more, either *Orthoptera* or *Neuroptera*, are from the Carboniferous. Three are *Hymenoptera*, forty-five are *Diptera*, six are *Hemiptera*, all from the Tertiaries. Three are *Lepidoptera*, viz., one doubtful from the Carboniferous and two from the Tertiaries, one of which is also doubtful. Two are *Myriapoda*, both from the Carboniferous, but one of doubtful character. No spiders have been found fossil in America.

From this it appears that the *Diptera*, *Hemiptera*, *Hymenoptera*, and *Lepidoptera* (omitting the doubtful ones from Illinois) are restricted to the Tertiaries; the *Coleoptera*, with one Triassic exception, to the same; the *Orthoptera* and *Myriapoda* to the Carboniferous; while the *Neuroptera* are found in both the Devonian and Carboniferous formations.

Boston, U.S., *November 25th*, 1867.

NOTICES OF MEMOIRS.

I.—Mr. David Forbes' Researches in British Mineralogy.

MR. FORBES has published in recent numbers of the "Philosophical Magazine" a series of papers, in which he proposes to record, from time to time, the results of his investigations in British Mineralogy. In these communications it is his intention, to use his own words, "besides treating of the physical character and chemical composition of the minerals under consideration, to pay especial attention, whenever it is practicable, to their association, paragenesis, and mode of occurrence, as connected with the petrology and geology of their localities, in order thereby to elucidate, as far as possible, the origin and formation of the rock-masses, or mineral veins, in which they may happen to be imbedded." Before proceeding to the task in question, he devotes some attention to the present position of this branch of science in the United Kingdom, and finds that, though the labours of British mineralogists in the first third of the present century gained for British science a position "of which the country might well be proud," the advances which have since been made are mainly due to the researches of Continental inquirers. This unsatisfactory state of things he ascribes to the superior attraction of palæontology on the one hand, and organic chemistry on the other, and fears, moreover, that the British geologists of the present day often undervalue the importance of a knowledge of mineralogy for the successful pro-

secution of petrological investigations. Speculations are made on the chemical changes which our rock-masses have undergone before we are in possession of accurate data respecting the mineralogical character and chemical composition of the rocks themselves. "Only very few chemical analyses of British rocks have been made," and it is humiliating to learn that, "in this respect, England stands far behind the rest of Europe; France, Germany, Russia, and even the small kingdoms of Norway and Sweden are far in advance with regard to the knowledge of the chemical and mineralogical composition of their rocks." Through the absence of exact information on this important subject, the nomenclature at present used by petrologists "is altogether inadequate to the demands of the more advanced state of the other branches of geological inquiry; in geological surveys and maps it is common to find eruptive rocks of totally different mineral and chemical composition and age confounded with one another, and, in other cases, to find rocks coloured and described by names that do not pertain to them. In fact, the present state of classification and nomenclature of the eruptive rocks is such that it becomes impossible to know with any certainty what exact rock may be intended or mapped under the names generally in use." The science of mineralogy, as expounded in text books, is too apt to be considered merely to treat of the physical, chemical, and crystallographic characters of mineral species, and to end here. "The study of their mode of occurrence, association, and paragenesis, as well as of their origin and the relations which they bear to the geology of the matrix in which they are embedded, is one of the highest importance and interest to the mineralogist." These considerations are generally neglected, and it has become customary to regard the presence of minerals in rock masses as accidental, and to shirk the question of their origin. It is evident, however, their presence is due, not to chance, but to the operation of definite laws; and to this important subject the author directed his attention. His researches have led him to certain general conclusions, which are given. "Excepting only the smaller number of species which make up the bulk of rock masses in general, it was found that most other minerals when occurring in eruptive rocks, even when met with in the most widely separated parts of the globe, present themselves under similar conditions, have the same associated minerals along with them; and that the eruptive rocks in which they occur, whenever the age of their intrusion could be satisfactorily ascertained, frequently, if not always, corresponded in geological chronology." In the eruptive rocks by far the greater number of mineral species have been found; and in all parts of the globe the same or very analogous minerals are, as a rule, found to accompany the outbursts of similar eruptive rocks. Far, therefore, from regarding the appearance of minerals in eruptive rock-masses as accidental or extraneous, the author holds that more extended and accurate investigation will demonstrate, that, in like manner as the occurrence of certain fossils or groups of fossils enables the geological age of a sedimentary bed to be deduced, so will the presence of certain minerals, or classes of minerals, serve

as a means of identifying the contemporaneous intrusions and outbursts of the eruptive rocks, which, at different geological epochs, have disturbed the earth's external crust." It was, likewise, observed that "whenever the same mineral is present in two or more rocks of different geological age, it is usually, if not invariably, characterised in each case by certain peculiarities, either in physical structure or chemical composition, which serve to distinguish it under the different circumstances of occurrence." This is shown to be true of felspar, mica, augite, garnet, apatite, hornblende, etc. In short the minerals generally regarded as accidental and extraneous, oftentimes form the real characteristic of the rock-masses containing them.

The author's labours on this important question have been greatly retarded by the great scarcity of facts which were found available. This is principally due to the neglect of mineralogists to record in their description of minerals their mode of occurrence, their mineral association, and the nature and age of the rock in which they are imbedded, as well as to the want, already mentioned, of chemical analyses of many of even the most common British mineral species. Of the 306 British species and sub-species described in one of the most recently published manuals of mineralogy of the British Islands, 164 have not yet been examined; and, it would scarcely be believed, that amongst these are included such minerals as hornblende, augite, orthoclase, labradorite, chlorite, talc, garnet, tourmaline, olivine, epidote, serpentine, beryl, etc. Moreover, our present knowledge of the composition of British rocks is of an equally unsatisfactory kind. "May it not now be fairly asked whether the natural inference to be deduced from these facts is not, that it is high time for British mineralogists and geologists to set to work, in order to supply these deficiencies before occupying themselves in propounding vague theoretical explanations, to account for the origin and metamorphosis of rocks in the field?" In the author's papers are given a description and analyses of the following British minerals.

Gold from the Clogau Quartz Lode, No. 2.—The lode occurs in the Lower Silurian Lingula beds, close to their junction with the Cambrian strata of the Geological Survey; it runs about 18° north of east, and dips at an angle of 88° to south, cutting through both fossiliferous strata and the intruded diabases, which are described as greenstones in the Survey; and it is, consequently, of later geological age than both these rocks, and is not improbably younger than the Silurian formation as a whole. The explorations appear to indicate that the lode is more auriferous at the parts where it cuts through the Lingula beds, with their accompanying diabases, than at greater depth where it traverses the Cambrian grits. Among the accessory minerals found in the lode are tetradymite, iron pyrites, chalco-pyrite, galena, chlorite, calcite, dolomite, chalybite, and heavy spar, which, as well as the gold, are distributed very irregularly in the quartz. When the quartz contains calcite, dolomite, and chalybite, or includes fragments of neighbouring clay-slate, it is regarded as likely to be more auriferous than when the lode consists of quartz only. When isolated fragments of the slate are found in the quartz of the lode, the

gold and other metallic minerals are commonly found adhering to or crystallizing on their under surfaces, which may have arrested these minerals in the act of being carried into lode-fissure from below with the stream of liquid quartz. The specific gravity of one specimen of gold was found to be 17·26, and two analyses showed the per-centage composition of gold 90, silver 9·25, the remainder being quartz. These numbers closely agree with the formula Au_8 Ag. Another alloy, lighter in colour and probably richer in silver, is sometimes met with in the lode.

Stream Gold from the River Mawddach.—A specimen of the dust washed from the bed of the river near Gwynfyndd, some eight miles from Dolgelly, contained small, flattened, elongated spangles of gold, the largest having the size of a pin's head, accompanied by abundance of fine black sand, supposed to be magnetite, but found to be titanoferrite, together with some small particles of quartz, slate-rock, mica, iron pyrites, and galena. The gold was found to have a specific gravity of 15.79, and the following composition: gold 84·89, silver 13·99, iron 0.34, and quartz 0·43. Several spangles had a peculiarly rich yellow colour due to a thin film of sesquioxide of iron adhering to their surface.

Titanoferrite.—The basaltic or doloritic rocks of the South Staffordshire coal-field invariably contain a small amount of a heavy black metallic mineral, strongly attracted by the magnet, and generally regarded as magnetic oxide of iron, whilst analysis showed it to be titanoferrite. Removed from the pulverised rock by means of a magnet, it was found, on examination, to have a specific gravity of 4·69, and a composition closely approximating to the formula $Fe_2\ 0_3\ Ti\ 0_2$. The associated minerals, distinguishable only in thin sections when viewed under the microscope, are a triclinic soda-lime felspar, augite, and a small quantity of what is probably seladonite, whilst pyrites, apatite, and a zeolitic mineral are likewise occasionally present. An examination of specimens of these basaltic rocks from each eruptive boss in Staffordshire, as well as others from the intrusive masses occurring in coal-pits, showed that titanoferrite is invariably present, and is consequently an essential constituent of the rock itself. It is, moreover, that variety of titanoferrite, which usually accompanies the eruptive rocks of Palæozoic age. The presence of titanium not only serves to characterise the basalts of this district, but likewise affords a means of detecting these rocks where altered by metamorphic action, and of referring tuffs, clays, etc., formed from them, to the original source. Two instances furnishing proofs of this are mentioned.

Polytelite from the Foxdale Silver Lead Mine, Isle of Man.—This mineral has been found in quantity sufficient to make it an object of commercial consideration. The lode wherein it occurs cuts through both the Lower Silurian and the eruptive granite; the latter appeared subsequent to the deposition to these beds, and is identical in its mineralogical character with the auriferous granites of other parts of the globe. The minerals associated with the polytelite are galena, chalcopyrite, iron pyrites, zincblende, quartz, dolomite,

chalybite, and calcite. The characters of the mineral itself are as follows: massive; opaque; lustre metallic; colour brown-black; streak black to brown-black; fracture sub-conchoidal, uneven, and granular, brittle; powder black; hardness, 3·5, scratching calcite, but not fluor; specific gravity, 4·97. Analysis led to the following numbers: sulphide of silver, 15·67; sulphide of antimony, 34·82; sulphide of copper (Cu S), 34·26; sulphide of iron, 7·57; sulphide of zinc, 7·18; and sulphide of lead, 1·66. These results differ but little from the composition of specimens of polytelite from other localities to which the formula 4 (Cu_2, Ag, Fe, Zn, Pb) S, Sb S_3 is attributed; it appears not unlikely, however, that in such metallic sulpho-salts the copper may really be in the form Cu S.

Polytelite from the Tyddynglwadis Silver Lead Mine, N. Wales.—This mine lies in the valley of the river Mawddach, near Dolgelly, and is close to the junction of the Cambrian rocks with the Lower Silurian Lingula beds, the main lode cutting through the Menevian group with its associated diabases. The polytelite is disseminated in the lead ores of this mine, and was with difficulty isolated in sufficiently pure a condition for analysis. Its associated minerals are native gold, native silver, galena, chalcopyrite, blende, iron pyrite, arsenical pyrites and quartz. Assays showed the polytelite to contain 11·25 per cent. of silver. In the washing of the ores of this mine it had been noticed that the lighter slimes were the richer in the precious metals, which the author imagined to be due to the greater part of the silver occurring in the form of polytelite (specific gravity 4·8), and not as a constituent of the galena (specific gravity, 7·7). He succeeded, by careful washing, in separating the metallic portion of the powdered ore into two layers, the lighter in which was most of the polytelite, containing 182 ounces of silver per ton, and the denser, consisting of argentiferous galena, yielded 60 ounces of silver per ton.

Sulphides of Iron and Nickel.—The sulphide of iron and nickel from the nickel mine, near Inverary Castle, Argyllshire, possessed the following characteristics: massive; fracture between granular and semicrystalline; brittle; opaque; lustre metallic; colour, light bronze-brown; hardness, 3·5; strongly magnetic; specific gravity, 4·5. It was composed of 38·01 per cent. sulphur, 50·66 iron, and 11·33 nickel; and is probably to be regarded as composed of Millerite and pyrrhotine. Some specimens of nickeliferous pyrrhotine from this mine are studded with brass-yellow spots resembling iron pyrites, and after the lapse of some years the double sulphide becomes disaggregated, whereby the separation of the yellow mineral can be effected. Its specific gravity was found to be 4·93, and its composition: sulphur 43·32, iron 45·73, nickel 1·99, cobalt 1·24, copper, 1·18. The iron pyrites appears to have segregated out of the general mass, carrying with it the cobalt and copper, scarcely a trace of cobalt being found in the pyrrhotine; and there appears to be a tendency on the part of cobalt to associate itself with bisulphide of iron, whilst nickel appears to prefer uniting itself with the magnetic sulphide. A chemical examination of several hundred

specimens of iron pyrites and magnetic pyrites taken from mineral lodes and eruptive rocks, proved that nickel was very rarely found in iron pyrites, when unaccompanied by pyrrhotine, but that cobalt was very commonly present in small quantity,—and, on the other hand, that cobalt was equally seldom present in magnetic pyrites if unaccompanied by iron pyrites,—also that when both these metals were present in a specimen of pyrites, the nickel greatly preponderated when the pyrites in question was magnetic, whilst the reverse was found to be the case in the ordinary iron pyrites. A specimen of sulphide of iron and nickel from the Craigmuir mine, near Inverary, was likewise examined. The lode in this district traverses metamorphic strata, and is disturbed by intersecting trappean dykes. The characters of this mineral agreed closely with those of the specimen already mentioned, its specific gravity was 4·602, and its composition: sulphur 37·99, iron 50·87, nickel 10·01, and cobalt 1·02.

Gersdorffite from the Craigmuir Nickel Mine, near Inverary.—This mineral occurs in a small string or cross-course intersecting the main lode of sulphide of iron and nickel. The specimen examined was a compact aggregate of minute indistinct crystals along with quartz and a talcose mineral. In places, patches and strings of copper pyrites were visible, but little or no sulphide of iron and nickel occurred with it, although this last-mentioned mineral formed the mass of the lode. The characters of the mineral are as follow: crystallized; opaque; lustre metallic; colour, white to greyish white, tarnishing to a greyish-brown tinge; streak, black; powder, blackish grey; fracture, granular; brittle; hardness, 3·75, rather below fluor spar; specific gravity of two specimens, 5·65 and 5·49. The percentages of the analyses accord with the formula $Ni\ (S\ As)_2$, and show the British mineral species to bear a resemblance to the crystallized specimens from Schladming in Styria.

II.—The Bone-Caves of Brazil and their Animal Remains.

By Professor Reinhardt.

THIS distinguished author, well known to zoologists by his numerous and valuable contributions to the history of Mammals (especially *Cetacea*), Birds, Reptiles, Fishes, etc., has favoured one of the popular scientific journals[1] of his country with a detailed and very interesting account of "The Bone-Caves of Brazil and their Animal Remains;" a subject on which Professor Reinhardt, through his repeated travels in that country, and his familiarity with its recent and Post Pliocene fauna,[2] must be regarded as one of the first authorities. In the hope that one of the many popular scientific reviews and journals of England will give its readers the pleasure of becoming acquainted with his memoir *in extenso*, through a

[1] Tidschrift for populare Fremstillinger af Naturnidenskaben, udginet af C. Togh az C. Lütken, 1867.

[2] Dr. P. W. Lund's collections from the Brazilian Caves in the Museum of Copenhagen are entrusted to the care of Prof. Reinhardt.

translation, we shall here restrict ourselves to giving in the author's own words the general conclusions with which he sums up the most important results of his careful studies on the subject.

"1. During the Post Pliocene epochs, Brazil was inhabited by a very rich Mammalian Fauna, of which the recent one might almost be said to be a mere fraction or a crippled remnant, as many of its genera, even families and sub-orders, have vanished, and very few been added in more recent times.

"2. During the whole Post Pliocene epoch the Brazilian Mammalian Fauna had the same peculiar character which now distinguishes the South American Fauna, compared with that of the Old World; the extinct genera belonging to groups and families, that to this very day are peculiarly characteristic of South America. Only two of its genera, the one extinct (Mastodon), the other still living (the Horse), belong to families that in our epoch are limited to the Eastern Hemisphere.

"3. All the Mammalian orders were not in the same degree richer in genera in former times than now. The Bruta, Ungulata, Proboscidea, and, lastly, the Feræ, have relatively suffered the greatest losses. Some orders, for instance the Chiroptera and Simiæ, number perhaps even more genera now than formerly.

"4. The Post Pliocene Mammalian Fauna of South America differed much more from the modern one, and was especially more rich in peculiar genera, now extinct, than the corresponding fauna of the Old World.

"5. The scantiness of great Mammalia—one might say the dwarf-like stamp impressed upon the South American Mammalian Fauna of our days, when compared with that of the Eastern Hemisphere, was much less observable, or rather did not exist in the prehistoric Fauna. The Post Pliocene Mastodonts, Macraucheniæ, and Toxodonts of Brazil, its many gigantic Armadillos and Sloths could well rival the Elephants, Rhinoceros, and Hippopotami, which during the same period roamed the soil of Europe." X.A.

REVIEWS.

NOUVELLES RÉCHERCHES SUR LES ANIMAUX VERTÉBRÉS DONT ON TROUVE LES OSSEMENTS ENFOUIS DANS LE SOL ET SUR LEUR COMPARAISON AVEC RES ÉSPÈCES ACTUELLEMENT EXISTANTES. Par PAUL GERVAIS. 1re. série. Illustrated by 50 plates and numerous woodcuts. Arthur Bertrand, Paris, 1867. 4to.

THIS work, of which we have the first five numbers before us, is announced to be completed in thirteen parts, each of 24 pp., accompanied by four lithographic plates and woodcuts.

The first division of the work treats of the Antiquity of Man and the Quarternary Period

After giving a short history of the opinions that have beeen expressed since the attention of geologists was first turned to this subject, the author recounts some of the discoveries which led scien-