rounded and open. The body consists of five unequal-sized calcareous plates closely soldered together, and having their surface covered with small granulations. The plates are each slightly convex, and the lines of the sutures well defined. The species appeared to me to be identical with one of the forms figured by M. Deslongchamps in the memoir referred to from the Middle Lias of May.

Without committing myself to any opinion as to the true position of *Cotylederma* in the zoological series until I have an opportunity of examining the structure more in detail, I desire now only to record the fact of the discovery of this genus in the Middle Lias of Dorset, as it is the first English specimen of this curious form of the Liassic Sea which I have yet seen in any collection from our Lias beds.

NOTICES OF MEMOIRS.

I.—On the Discovery of Batrachia in the Upper Palæozoic Rocks of France. *Sur la découverte de Batraciens dans le terraine primaire, par M. Albert Gaudry.* Bulletin de la Société Géologique de France, 3e série, t. iii. p. 599, pl. vii. et viii.

IN the spring of the present year M. Albert Gaudry communicated an interesting paper to the Geological Society of France, on some newly discovered remains of true Batrachia found in the older rocks of that country, and which paper has just been published, with two plates, in their Proceedings. This discovery is palæontologically important; as the author observes that up to the present time no remains of actual typical Batrachia have been found in any rocks of earlier date than the Tertiary Period. It has also been a subject of surprise, that Vertebrates of so low an organization should have appeared so late upon the earth, and this supposed fact has been used as an objection to the theory of progressive development. However, this discovery, he thinks, shows structural characters, such as an evolutionist would expect to find in an ancient rock. The tail very short, the bones of the trunk and limbs resembling those of the Salamanders, whilst on the contrary the bones of the head have the characters of those of the Frog; thus lessening the distance which appears to separate the *Urodela* from the *Anoura*. He further remarks, that the incomplete ossification of the centra of the vertebræ, the want of ossification of the epyphyses of the limb bones, and probably, also, the cartilaginous state of the carpals and tarsals, reveal a type of which the evolution is not yet completed. Like the earlier Mammalia, these Batrachia are very small, thus giving them the appearance of animals not fully developed. But he thinks it probable that most of the individuals he examined were adults, for they varied but little in their proportions. The specimens were found at Muse (Saone et Loire), and at Millery, in the schists from which petroleum is extracted. At this place a slab was obtained showing remains of seven individuals more or less perfect. These schists are considered by some geologists to belong to the upper beds of the Coal-measures, but are

more generally referred to the Permian Formation; but this diversity of opinion is of little importance in regard to these remains, as it is certain that these bituminous schists belong to the upper series of the Palæozoic rocks of France. Remains of seventeen individuals have been obtained, one only being from Muse; the two largest are respectively 45 and 35 millemetres long from snout to end of tail, whilst the Muse specimen is but 30 millemetres in length.

Although the skeleton appears smaller, M. Gaudry does not think it constitutes a specific difference. The osteological characters, and the points of agreement with, or divergence from, the corresponding bones in the Frogs and Salamanders, and also in some of the extinct genera of the Amphibia, are fully stated; but these comparisons, although interesting, are too long for quotation.

The osteological evidence for considering these remains to be those of true Batrachia are, the large size of the head of *Protriton*, the great eye orbits, the absence of the suprasquamosals, and also of the entosternum and episternum, together with the very small ribs, —these characters have a marked resemblance to the Batrachia, and more especially to the Salamanders. There are, however, some important differences; notably the head is relatively very much larger than that of the aquatic Salamanders, and is also proportionally larger than in the terrestrial Salamanders; the vertebræ are not so completely ossified; the neck has three vertebræ, the Salamander but one; the dorsal and lumbar vertebræ are shorter and more numerous; the ribs are less arched; the lumbar vertebræ carry no ribs, and the tail is only a fifth of the total length of the body, whilst in most of the Salamanders it is equal to the half of the entire length. The anterior and posterior limbs are directed backwards, thus more resembling the Ganocephala than the Batrachia. It is probable, when more perfect examples of *Protriton* are found, in which the bones of the scapular and pelvic arches are shown, that more numerous differences than those at present observed may separate *Protriton* from the *Urodela*.

M. Gaudry thinks that *Apateon pedestris*, v. Meyer, from the bituminous schists of Appel Münster, is closely allied to *Protriton*, and that Prof. Wyman is of opinion that *Raniceps* (*Pelion*) *Lyelli*, from the Coal-measures of Ohio, is also a true Batrachian. There is therefore evidence of the early existence in Geological time of members of this family in France, Germany and North America. He proposes the name *Protriton petrolei*, as indicating that these remains are the predecessors of the Salamanders, and that they were first found in rocks producing petroleum.—W. Davies.

II.—On the Formation of Metallic Sulphides and other Minerals in the Thermal Spring of Bourbonne-les-Bains (Haute-Marne). By M. Daubrée. Comptes Rendus, vol. lxxx. 1875.

IN carrying out some works connected with the thermal spring of Bourbonne-les-Bains, some interesting facts have been brought to light. At the bottom of an ancient well, a bed of blackish mud

was found, containing in its upper part many vegetable remains, and in the lower, numerous medals of bronze, silver and gold, as well as other works of art of Roman age. Below this was a bed consisting principally of fragments of sandstone, which were more or less cemented together by metalliferous minerals definitely crystallized.

M. Daubrée's attention was directed to this interesting circumstance by the Minister of Public Works, who had received specimens from the chief engineer of mines, M. Trautman.

Notwithstanding the resemblance of these minerals to those of older geological date, they have evidently been produced after the embedding of the Roman medals with which they were associated, for, in many instances, the medals were encrusted and enveloped by them. The following species were recognized:—

Copper Glance, in crystals similar to those found near Redruth, in Cornwall, and associated with Covelline.

Copper Pyrites crystallized and mammillated.

Erubescite in regular octahedrons, and cubes with faces slightly curved.

Tetrahedrite in crystals with its usual lustre and other characters, and from the analysis representing a type nearly free from arsenic.

Of these minerals, the most novel is the formation of the double sulphide of copper and antimony constituting Tetrahedrite, for the other species have been previously observed under somewhat similar conditions in other localities.

Besides these, occur numerous rounded grains of quartz, cemented with sulphides, as well as some doubly-terminated crystals of the same mineral, resembling the Compostella Hyacinth. Whilst some of these are derived from the *grès des Vosges*, others appear to have been the result of a contemporaneous crystallization with that of the Tetrahedrite, etc.

The formation of these sulphides is evidently connected with the thermal spring, the water of which contains in solution chlorides and sulphates of the alkalies, lime and magnesia, as well as bromides, and carbonates of iron and lime, an alkaline silicate, and traces of arsenic and manganese. The solid contents are about 7 to 8 grammes per litre, and the temperature is about 60°.

In explaining the formation of these metallic sulphides in the midst of the mud and under the influence of the mineral water which has constantly penetrated it, M. Daubrée considers that the sulphates have been partially reduced to sulphides by the action of the vegetable matter present, a well-known reaction in nature.

The presence of antimony, an essential element in tetrahedrite, is particularly interesting, for, though its presence has been determined in mineral springs in other localities, it has not been recognized at present in that of Bourbonne-les-Bains. It has been, therefore, probably derived from the minerals used in the manufacture of the bronzes, traces of this metal having been found in ancient bronze by M. Fellenberg.

The medals present a curious modification. Most of them, whilst retaining their general form, have lost their sharpness of outline, so

that, while the interior still shows the lustre and colour of bronze, the exterior consists of a white earthy crust, consisting chiefly of oxide of tin, slightly coloured by traces of copper salts. Thus, by reason of the different chemical affinities of the metals composing the medals, the copper has entered into sulphur combinations, whilst the tin has passed into the state of oxide. This accounts for the mode of occurrence of tin, which is generally found in the state of oxide, even when sulphides, as mispickel, are found associated with it in the same vein. The antimony, notwithstanding its analogies with tin, differs from it in these modern products, as in metalliferous veins, by being invariably in combination with sulphur.

The silver medals are not altered.

Geologically short as is the time during which these reactions described by M. Daubrée have taken place, yet they supply important results, and afford new evidence of the influence of mineral springs in the formation of metallic sulphides, such as may partly assist in explaining the filling of mineral veins with similar substances.

Further research has brought to light other facts, as the occurrence of galena, anglesite, mammillated limonite, and iron pyrites.

The cavities in the bricks used in the conduit for the thermal waters are sometimes found lined with small rhombohedral crystals of chabasite, also some small colourless crystals having the form of rectangular prisms similar to those which occur under analogous circumstances at Plombieres, and which are referred to phillipsite or lime-harmotome.[1]

It thus appears that the zeolitic minerals of the two localities cited, as well as at Luxenil previously described by M. Daubrée,[2] are the result of similar reaction, producing silicates which did not originally exist in the concrete, but which have resulted from the long-continued action of the contents of the thermal waters upon the materials used in the construction of the conduit. It is to be remarked that the water of Bourbonne-les-Bains differs considerably from that of Plombieres, which contains a far less amount of soluble salts, about ·3 gramme per litre; this difference has, however, not affected the formation of zeolites in both.

M. Daubrée concludes by pointing out that thermal springs, flowing at limited depths and at slight pressure, produce mineral substances which have not yet been formed in our laboratories. How important, then, must be their effects at greater depths and greater pressure, reacting upon the different rocks which they traverse, and thus produce changes at present veiled to our view, but which should not be overlooked in the consideration of formations which come within the ken of the mineralogist and geologist.

J. Morris and Thomas Davies.

[1] Comptes Rendus, t. xlvi. p. 1806. (1858.)
[2] Bulletin de la Société Géologique, 2nd ser. t. xviii. p. 108. (1860.)