ORDINARY MEETING.

THURSDAY, JANUARY 7TH, 1886.

W. TOPLEY, Esq., F.G.S., Assoc. I.C.E., President, in the Chair.

The donations to the Library since the last meeting were announced, and the thanks of the Association accorded to the donors.

The following gentleman was elected a Member of the Association:—Arthur M. Brown.

H. H. French and H. M. Klaassen were elected Auditors.

The following papers were then read:—

'Remarks on some Phenomena observed in the Devonian and Carboniferous Beds in Belgium.' By M. E. Dupont.

An additional note to his paper on 'Flightless Birds.' By Henry Woodward, F.R.S.

'Note on the Large Bird from the Eocene of Croydon, found by Mr. H. M. Klaassen.' By E. T. Newton, F.G.S.

REMARKS ON SOME PHENOMENA OBSERVED IN THE DEVONIAN AND CARBONIFEROUS BEDS IN BELGIUM.

E. DUPONT,

Director of the Geological Survey of Belgium, and of the Royal Museum, Brussels.

(Translated by MISS MARY FORSTER, *Lecturer in Geology, Bedford College, London.)*

During the excursion in Belgium in the month of August last the Members of the Geologists' Association were able to study most of the beds of the palæozoic series of this region, and to examine specially their relations to each other by passing transversely across nearly the whole of the palæozoic tract.

At the request of the President, Mr. Topley, I here offer to the Association some general considerations on these beds.

The palæozoic rocks of Belgium present themselves in two great basins—the southern, or that of Dinant, which is the most considerable, and the northern, or that of Namur.

In the former the Lower Devonian beds lie unconformably on Cambrian or Silurian rocks. From the lowest beds of the Lower Devonian—those which we were able to study to such advantage at Fépin, under the guidance of M. Gosselet—to the Coal-Measures inclusive, all the series of Devonian and Carboniferous strata are developed concentrically without a break in the order of the numerous beds of which they are formed. But it should be remarked that this concentric arrangement is complete in a way in which no other series, either Devonian or Carboniferous, is so, as regards the stratigraphical relations to beds above and below.

This southern basin forms a sort of tub, which, during the long Devonian and Carboniferous periods, has been filled up gradually, without its brim having been reached, in consequence of movements which altered its planes of bedding.

This phenomenon is extremely striking on account of its contrast with the arrangement of the Cretaceous and Tertiary series which extend to the north of the palæozoic region. Our Cretaceous and Tertiary beds are particularly characterised by the multiplicity of their stratigraphical relations, so that instead of a regular concentric order the greatest variety of conditions in the extent of the beds prevails.

But our palæozoic rocks suggest other reflections. We have seen that the Middle Devonian is composed of great masses of limestone, enclosed among beds which are generally shaley,and that the Carboniferous-limestone series is almost exclusively made up of limestone.

Members of the Association will remember that I was able, by means of large specimen slabs, to demonstrate to them that these limestones are exclusively of organic origin, they being formed sometimes from agglomerated coral, sometimes from *débris* of crinoids, and sometimes from the pulverulent detritus of these limestones. Therefore, in these several cases they have originated in the same sea, without any extraneous material having intervened in their formation.

Very different is the origin of the shales, sandstones, and conglomerates, which make up the remainder of our Devonian series. These sediments did not, like the preceding, originate in the sea; they are a manifest production of the neighbouring land. The question arises whether they were not carried away

by the waves from the coasts themselves and then transported by the currents into the basin. We are able to answer this question.

In fact, from the base of the Lower Devonian to the Coal-Measures we do not at first find any traces of cliffs, all the beds occurring regularly in conformable succession, and, in the second place, the *Stringocephalus*-limestone presents the peculiarity of surrounding the basin of Dinant with an almost entirely continuous girdle. Its formation was followed by the deposition of very thick layers of shales and psammites, constituting part of our Middle and all of our Upper Devonian. If the component parts of these shales and psammites had been swept away off the coasts by the waves they would consist of limestone, and not of sands and clays. We are, therefore, led to regard the quartzose and schistose rocks of our Devonian not only as being of terrestial origin, but as having been brought into the sea by the rivers. This conclusion is confirmed by the repeated variations occurring in the lithological character of these quartzose and shaley beds at the same horizon. Nothing is more variable than the facies of these beds in our palæozoic area. A stratum is here shaley, and at a little distance it passes into sandstone, or sometimes into gravel, or even into a coarse conglomerate.

The study of the distribution of these rocks will, I think, without doubt, give us the means of determining the sites of the ancient river-mouths and the system of sedimentation that resulted from them. I had intended to devote this summer specially to the investigation of this point, but have been prevented by the circumstance that the Belgian Government has stopped the survey for the geological maps and the work of which they were the occasion.

However, if, following the usual method, we divide sedimentary deposits into two great classes (neglecting, of course, such deposits as are eolian, peaty, etc., etc.), namely, marine and fresh-water deposits, it is possible to sub-divide in their turn beds of marine origin into two principal categories: those which arise in the sea by the agglomeration of organisms, or by the accumulation of their detritus, and those which are brought in from elsewhere, either having been swept off the coasts or, more commonly, carried into the sea by the rivers. At the same

time there is good reason for establishing yet further subdivisions among the rocks originating in the sea, that is among the limestones, and these are of great importance, as their modes of formation are essentially different. I allude first to the limestones due to the agglomeration of corals which are built up as hillocks and banks at the bottom of the sea. The character of these rocks is, therefore, very peculiar. I have called them *Constructed limestones*. But the other limestones formed of detritus torn by the waves from more ancient limestones, or of *débris* of organisms such as crinoids, or even sometimes of foraminifera, etc., like the chalk, are the *Sedimentary limestones*, of which the character and disposition are essentially the same as those of argillaceous and sandy sedimentary rocks.

The Association was enabled to verify in the section at Senzeilles the passage of the Middle Devonian with the *Rhynchonella cuboides* and *Cardium palmatum* beds, to the Upper Devonian of *Cyrtia Murchisoniana*. At Grupont the passage of the Lower Devonian (beds of *Spirifer cultrijugatus*) to the Middle Devonian (beds of *Calceola sandalina*) was shown. In the first case the palæontological passage is abrupt —when the fauna of the Middle Devonian disappears the fauna of the Upper Devonian appears—but the mineral character of the beds differs generally so little at the level of this palæontological modification that it is impossible to trace the separation lithologically. So much is this the case that the limits of the two formations can only be recognised by a laborious search for fossils. A similar case presents itself between the Lower and Middle Devonian. We were able to see in the beautiful section of Grupont that there, where the lithological character of the beds varied the most, there was no palæontological change noticeable, while in places where the mineral aspect is the most continuous there comes in a rapid palæontological transformation as important as the replacement of the Lower Devonian fauna by that of the Middle Devonian.

We have thus two examples, at distant points of the stratigraphical series, of a discord between the lithological and palæontological characters, and this is not one of the least interesting peculiarities of the Devonian beds in Belgium.

These facts seem somewhat less strange when we remember

the conclusions we arrived at above on the origin of the quartzose and argillaceous deposits of this series.

If, as I think, the deposits were brought in by rivers, the changes that these last underwent in their sedimentary supply had not sufficient influence on the evolution of the faunas to give rise to any considerable modifications.

It follows that the causes of these modifications should be sought for otherwise than in the sedimentation. I think it would not be impossible to account for them by appealing to well-known natural phenomena, but the application of these to the case here under consideration seems to me premature in the present state of our researches.

These various considerations are of more special importance in a detailed investigation of a series of beds. They enable us, I think, to give an account of many circumstances that appear inexplicable if we content ourselves with regarding the beds in detail in the same manner as we study them in their great masses.

Note on the Large Bird from the Eocene of Croydon, Found by Mr. H. M. Klaassen.

By E. T. Newton.

Mr. H. M. Klaassen, in his detailed description of the Lower Eocene strata exposed in the Park Hill Railway Cutting at Croydon ('Proc. Geol. Assoc.,' Vol. viii, p. 226, 1883), called attention to the finding of some large bird bones in the "Blue Estuarine Beds" immediately overlying the "Mottled Clay" (*op. cit.*, p. 240).

These bird remains have been described in a paper read before the Zoological Society, and not yet published;* but it was thought that a short account of them would be acceptable to the members of this Association.

The bones were found at different times, but all in the North cutting, and within, perhaps, 100 yards of each other. They represent at least four individuals, three adults and one very young one.

It will be remembered that Mr. Klaassen was fortunate

* Since published, 'Proc. Zool. Soc.,' May, 1886. Ed.