

ABSTRACTS OF BRITISH AND FOREIGN MEMOIRS.

I.—AMMONITES FROM THE HIMALAYAS, ETC.

(PALÆONTOLOGISCHE MITTHEILUNGEN. Nos. IV. and V. von Prof. Dr. A. OPPEL.)

IN this, his third contribution to Palæontology, Dr. Opper first concludes his descriptions and figures of the Ammonites which are contained in the Schlagintweit collection of fossils from the Secondary formations of the Himalayas, and the discussion of which was commenced in the second part of the "Mittheilungen." The formations represented by these fossils appear to be equivalents of the Kelloway rock, Oxford Clay, and Hallstädt beds of Europe; but the author makes some cautious reservations on account of considerations founded on the inferred existence of "Homoiozoic belts" during the Jurassic period.

The succeeding memoir is devoted to a Geological Study of the Department Ardèche, in which the author recognises the Oxford Clay, Kelloway rock, and part of the Bath Oolite. Dr. Opper describes the strata in the neighbourhood of Valence, and gives a section and copious lists of fossils, showing the stratigraphical and palæontological relations of the different beds, which he considers to represent the following zones of life:—

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|---------------------------------------|---|----------------|
| Zone of <i>Terebratula impressa</i> , | } | Oxford Clay. |
| " <i>Ammonites transversarius</i> | | |
| " <i>Ammonites cordatus</i> | | |
| " <i>Ammonites Lamberti</i> | | |
| " <i>Ammonites athleta</i> | } | Kelloway rock. |
| " <i>Ammonites anceps</i> | | |
| " <i>Ammonites macrocephalus</i> | | |
| Bath group. | | H. M. J. |

II.—ON CERTAIN JOINTS AND DIKES IN THE DEVONIAN LIMESTONES ON THE SOUTHERN SHORE OF TORBAY.

By WM. PENGELLY, F.R.S., F.G.S., ETC.

[Read before the Members of the Torquay Natural History Society, Nov. 8, 1865.]

MOST rocks are traversed by various kinds of divisional planes, some being coeval with the rocks themselves, whilst others have certainly been superinduced.

In stratified rocks the principal planes of division are those of stratification, lamination, foliation, cleavage, and jointage.

Stratification and lamination differ in degree only. Each marks a pause—greater or less—in the process of deposition or sedimentation. Foliation is chiefly confined to crystalline strata, and is applied to rocks composed of laminæ alternately of different kinds of mineral matter. The planes of lamination may or may not be inclined to those of stratification.

Cleavage is that tendency which occurs in many rocks—but

most distinctly in slates—to split into illimitably thin laminae, whose planes are more or less inclined to those of stratification.

Jointage is the name given to divisional planes which occur in both stratified and unstratified rocks, follow definite and constant directions through great tracks of country, and by their intersections resolve the rocks into blocks having constant forms.

The spaces between the joints are very variable, but, in virtue of the jointage planes, the rock is never capable of being split into illimitably thin plates.

The following are amongst the questions on which the geologist desires information respecting the rock-joints of any district. Their origin, their directions, and their ages, both in relation to one another, and to the chronological periods of geological science.

That they have been superinduced, or formed since the rock itself was formed, there can be no doubt; but it may be questioned whether any satisfactory explanation of their origin has been given to the world. There seems a general tendency to ascribe them chiefly to contractions in the mass of the rock during its consolidation. It has also been suggested that in some cases they may have been formed in a mass of rock that is in a state of tension from a mechanically expanding force. Professor Harkness supposes that in many instances they may be due to pressure; whilst others, in their despair, have invoked the aid of electricity, or some other polar force.

As long ago as 1839, it was remarked by Sir H. De la Beche that "As a whole the great divisional planes of Devon and Cornwall may be said to prevail more in directions from N. to N.W. and from S. to S.E. than in others, the greatest number holding their courses within a few degrees of N.N.W. and S.S.E.; these lines being cut by others, which chiefly form angles from 70° to 90° with them." (Report, page 274.)

It has long been known also that the joints which affect a more or less northerly and southerly direction always cut through, and are therefore more modern than, those which have a course approximately east and west; but so far as I am aware no definite information has been given beyond this on the chronology of joints. I am not without a hope that trustworthy facts will be produced in this brief communication by which the exact geological age of the north and south joints of Devonshire and Cornwall may be established.

The Devonian slates and limestones in the Torbay district are traversed by two well-defined systems of joints; one having a direction from N. 82° E. to S. 82° W., the other very nearly in the present magnetic meridian or about N. 23° W. to S. 23° E., so that the two systems intersect at nearly right angles. As a matter of convenience I shall in this communication speak of them as the east and west and north and south systems respectively. The first has commonly a considerable underlie towards the south, whilst the second system is in most cases sensibly vertical.

It is not my intention to enter on a consideration of all the phenomena and relations of these joints, but simply to call atten-

tion to a few probably unique facts connected with them, which are well displayed in the limestones along the southern shore of Torbay, and especially at a small beach almost immediately beneath Berry Head House, about midway between the Head and Brixham.

At the spot indicated, the limestones dip at a low angle towards the south or landward, and the joints of both systems are occupied with vertical dikes or wall-like masses of compact tolerably fine-grained red sandstone, which are traceable at by no means wide intervals from Berry Head to the Torbay and Dartmouth Railroad. There is no manner of doubt that the dikes belong to the Triassic or New Red Sandstone formation, which is so fully developed in the central shores of the bay. It may be presumed, therefore, that this formation formerly covered the Berry Head limestone: and, indeed, there is further evidence of this in the fact that diminutive outlying patches of red sandstone and conglomerate are met with here and there throughout the district. It is obvious too that both systems of *joints* were in existence during, but not necessarily before, the Triassic era.

A careful inspection of the dikes discloses the fact, that in every instance of intersection, the north and south series cut through those running east and west. It is also observable that there is a perceptible, though comparatively slight, difference in the colours of the two systems. We, therefore, advance another step, and conclude that the dikes running north and south are more modern than those through which they pass; but we may proceed still further; for it is obvious that had the north and south *joints* been in existence when those having an east and west direction were filled in with red sand, they would have been filled in also, and the two systems of dikes would have been of the same age; hence we may safely conclude that the north and south *joints* were formed after the east and west dikes, and therefore that the joints having a north and south direction are not only more modern than those running east and west, but that they were absolutely formed after the commencement of the New Red Sandstone era.

It requires but little reflection, however, to advance another step; for since the north and south joints are filled with red sandstone dikes, they must have been formed before the close of the Triassic era. Here, therefore, we have, what so far as I am aware, was never produced before, conclusive evidence that the north and south joints of the Devonian rocks of the Torbay district are of Triassic age; and assuming that the joints having the same direction in Devon and Cornwall generally, are all of the same age, it follows that the entire district is brought under this generalization.

These dikes, moreover, bring before us very prominently the enormous amount of time which the red rocks of this district represent; and this is seen most clearly when a ground plan or bird's-eye view of the phenomena is studied. It then appears (1) that the east and west dikes are not only intersected but faulted; and (2) that they are traversed by longitudinal veins of carbonate of lime, which do not enter the intersecting dikes. Hence we are

enabled to trace the progress of events somewhat in detail. We have :—

1.—The filling in of the east and west joints with red sand, at a period not earlier than, if so early as, the commencement of the Torbay Trias.

2.—The induration of this sand into coherent and durable dikes capable of being fissured and faulted without their sides falling in.

3.—The formation of longitudinal fissures in these dikes.

4.—The gradual filling up of these fissures, not with sand, but by the precipitation of carbonate of lime.

5.—The formation of transverse joints, passing in a north and south direction, through the dikes and veins, and the pre-Triassic rocks.

6.—The faulting of the entire mass, rocks, dikes, and veins, by inequalities of movement in an approximately horizontal direction.

7.—The filling in of the north and south joints with red sand, as in the first instance, so as to form dikes passing through those previously existing. The two systems being distinguishable by well-defined walls and a marked difference of colour.

All the events here detailed occurred within the era of the Torbay Trias, and, indeed, apparently during that portion of it in which sandstone alone was deposited, inasmuch as there are no traces of conglomerate in the dikes.

Before closing this brief communication, I would remark that though I am altogether unprepared to offer any opinion respecting the origin of the joints in question, it appears certain that at least those running north and south cannot be due to contraction in the mass of the rock during its consolidation; for the rocks themselves are of Middle Devonian Age, between which and the Trias we have the Upper Devonian, the Mountain Limestone, the Millstone Grit, the Coal Measures, and the Permian ages; so that it is simply impossible to suppose that the rocks had remained unconsolidated. Moreover, the fact that they were already traversed by east and west joints, is a decisive proof that they had assumed the solid condition.

BRITISH ASSOCIATION REPORTS.

SECTION C.—GEOLOGY.

I.—ON THE EXISTENCE OF GOLD-BEARING ERUPTIVE ROCKS IN SOUTH AMERICA WHICH HAVE MADE THEIR APPEARANCE AT TWO VERY DISTINCT GEOLOGICAL PERIODS. By DAVID FORBES, F.R.S., F.G.S., &c.

THE author believed that the gold deposits of South America had not as yet been studied with a view to determine the geological period at which the gold itself had made its appearance. The present communication was the result of observations made during seven years' travels over a large part of South America, and which had enabled him to class all the deposits of gold which he had visited, under two heads, both of which could be traced directly or indirectly to the intrusion or eruption of igneous rock.

Under the first head belonged all gold derived from the disinte-