into action by the contraction of the rocky barrier by which it was environed; while the modifications produced by seismic and volcanic force, together with exposure to destructive chemical and mechanical agencies through long-continued periods must be taken into account in endeavouring to arrive at a correct understanding of its lithological and petrological aspects. Without enlarging on the subject, it may only farther be remarked, that the thickness of the solid exterior of the earth is commonly reckoned to be about 45 miles; and if we deduct 10 miles for the thickness of the stratified rocks (which is practically an over-estimate, for it represents the depth of all the systems, or differentiated assemblages of strata tabulated in the order of time; and the series is nowhere known to exist in its entirety) we have 35 miles of the crust to account for. This is, properly speaking, the 'foundation' of the earth from which have been elaborated, by chemical and mechanical agency, the more superficial accumulations which contribute so largely to the convenience and comfort of the human race.

Some geologists continue to distinguish granite from the other unstratified rocks by the term 'Plutonic,' and others class it as a trappean rock. Its varieties might more properly be described as Cryptogene (of hidden origin) whatever shades of difference there may be in their composition, if they exhibit evidence of a common origin by their position and structure; for in granitic—let us say cryptogene—rocks there are many departures from the normal type, which consists of quartz, felspar, and mica; the hornblendic or syenitic varieties forming a stepping-stone to the trappean syenites, and indicating a close relationship between the two classes of unstratified rocks under reference.

NOTICES OF MEMOIRS.

I.—The St. Bees Sandstone and its Associated Rocks.[1] By J. G. Goodchild, F.G.S., H. M. Geological Survey.

THE author reviews the history of opinion upon the classification of the New Red Rocks of Cumberland and Westmoreland, and then gives the following as the maximum thickness, general succession, and probable equivalents elsewhere of these rocks:—

New Red Series (Upper Division).

	Maximum observed thickness in feet.
(5) Red marls with rock salt and Gypsum	950
(4) St. Bees Sandstone, with the following subdivisions:— (*d*) Waterstones; (*c*) zone of tile red phases; (*b*) dull Red Sandstone with local bands of fine conglomerate and occasional pebbles; (*a*) zone of variegated sandstones. In all	2000
(4*a*) Graduates downward into—	
(3) Gypsiferous marls with local conglomerate at its base...	300
Magnesian Limestone Group.	
(2″) Magnesian Limestone	25
(2′) Plant beds...	150
Lower New Red.	
(1) Penrith Sandstone: the Brockrams	1500

[1] Read before the Brit. Assoc., Edinburgh, August, 1892, in Section C (Geology).

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EXTENSIVE UNCONFORMITY.

There is a perfectly unbroken downward succession as far as the conglomerate at the base of (3); and, therefore, as (4*c*) is admitted on all hands to be of Triassic age, the remainder of (4) and the whole of (3) must be of Triassic age also; (3) lies indifferently upon either member of (2) or upon the upper part of (1); it is therefore slightly unconformable to the beds below. These are admitted on all hands to be Permian; therefore the break between the Trias and the Permian is at the base of (3). The author considers that the whole of these rocks form the natural basement beds of the Neozoic rocks, and that the dividing line between the Palæozoic rocks and the Neozoic age should be taken somewhere between the Red Rocks of the Salopian type (to which he would restrict the term Permian) and the true New Red, as the term is here employed. He considers that the New Red proper bears the same relation to the Jurassic and Rhætic Rocks that the Upper Old Red Sandstone does to the Carboniferous, and that the Salopian Permian may possibly occupy the same relation in regard to the Carboniferous rocks as the Glengariff Grits do to the Silurians. Some at least of the Salopian rocks may be simply Carboniferous rocks stained by infiltration from the New Red.

The author regards the St. Bees Sandstone as mainly equivalent to the Bunter, and proposes that the term Bunter Marls should be applied to the marls which here (and in Devonshire, etc.) occur at the base of that subdivision.

II.—THE IGNEOUS ROCKS OF THE NEIGHBOURHOOD OF BUILTH.[1] By HENRY WOODS, B.A., F.G.S.

AN account of the geology of the Builth district was given by Murchison in the "Silurian System" (1839), since which scarcely anything has been written on it. A series of igneous rocks, associated with beds of Ordovician age, stretches from near the town of Builth to beyond Llandrindod. In this paper the author confined himself to the southern half of this area, giving a preliminary description of the distribution and characters of the rocks met with, namely, diabase, rhyolite, porphyrite, andesite, and ashes.

III.—ON THE RELATIONS OF THE ROCKS OF THE LIZARD DISTRICT.[1] By ALEX. SOMERVAIL.

THESE rocks include the hornblende-schist, serpentine, gabbro, granite, etc., which the author regards as all belonging to the same period of geological time, and to have segregated or separated out from each other during the cooling of a homogeneous magma.

There seems absolute evidence in the field to show that the serpentine is a non-intrusive rock, that it was the first portion of the magma to cool, and is broken through by all the other rocks, but that it is intrusive into none.

The relations between the serpentine and the diorite and portions

[1] Abstracts of Papers Read before the British Association, Edinburgh, Aug. 1892.

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of the granulitic rocks are those of segregation, and not of intrusion, as many sections show these rocks associated together in great alternating bands with a concentric-like structure with complete transition varieties, but with no sign of intrusion on the part of either. These concentric-like structures, which are certainly original —due to cooling—have been subsequently displaced and broken up, so that the now isolated portions are mistaken for intrusive tongues of serpentine or included fragments of hornblende. When followed out they resolve themselves into what were once connected masses.

While the main masses of these rocks have separated out from each other, and cooled in the order of increasing acidity, there also seems absolute proof in the field that the intrusive dykes in the serpentine, consisting of diorite, granite, complexes of these and also of gabbro, are but portions of the uncooled magma of the main masses which were able to penetrate the serpentine.

That the main masses and the dykes are of one and the same age is evident, not only from their mineral composition and lithological aspect, but also from the fact that all these rocks are inter-related—for example, the gabbro and diorite dykes coalesce, and dykes of the former have margins of the latter. The diorite contains inclusions of gabbro, and in some instances inclusions of the latter contain others of the former. The granulitic rocks, diorite, and gabbro occur as a regular interbanded series, and there are also schists of these complexes.

The facts seem to warrant the following conclusions:—

1. That all these rocks belong to one geological epoch; that their relations are principally those of segregation or separation, and in a lesser degree of contemporaneous intrusion on the part of the less basic and more acid portions of the magma.

2. That the olivine portion of the magma now forming the serpentine was the first to cool, followed by the others in the order of their increasing acidity.

3. That the serpentine is a non-intrusive rock, and one into which all the other types of rock have been intruded, the granite intrusions being the latest.

IV.—On the Presence of Fossils in the "Azoic" Rocks of Brittany. By M. Charles Barrois. Comptes Rendus des Séances de l'Académie des Sciences, Vol. CXV. pp. 326–328, August 8th, 1892.

A BED of quartzite containing crystalline scales of graphite is intercalated in the gneiss of Morbihan. This gneiss passes laterally into mica-schists by the disappearance of felspar. It represents the azoic schists metamorphosed by the injection of "granulite." The graphitic quartzite can be followed for a considerable distance both to the north-east and south-west of the Vannes-sheet of the Survey Map, into regions less affected by the granulite. It is then found to be interstratified with mica-schists. M. Barrois has also determined the presence of the same band in the north of Brittany, where the rocks are far less affected by the

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intrusive granulite and the graphitic quartzite is represented by carbonaceous quartzites and phtanites. These rocks underlie the phyllades de St. Lô, and pebbles of them are found not only in the Cambrian but also in pre-Cambrian conglomerates. The carbonaceous phtanites of this horizon occurring at Lamballe (Côtes du Nord) contain radiolarian remains which have been identified by M. Cayeux as belonging to the group of the Monosphæridæ. These are the oldest fossils known in France, and probably in the world. The discovery is also interesting because it confirms the theory of M. Michel-Lévy as to the origin of the granulitic gneiss.

REVIEWS.

I.—Notes sur l'Histoire et la Structure géologique des Chaines Alpines de la Maurienne, du Briançonnais, et des Régions adjacentes. Par M. W. Kilian. Bull. de la Soc. Géol. de France. 3ème s., vol. xix (1891), pp. 571–661.

Sur l'allure tourmentée des Plis isoclinaux dans les Montagnes de la Savoie. Par M. Kilian. *Ibid.* pp. 1152–1160, pls. xxv.–xxvi.

THE first of the above papers contains the results of a series of explorations carried out by M. Kilian, on behalf of the Geological Survey of France, in a portion of the French Alps between the upper valleys of the Isère, the Italian frontier, and the upper valley of the Ubaye, and they are published in advance of a more complete monograph on the subject. The author's researches have been mainly devoted to the band of sedimentary deposits intercalated between the crystalline zones of Mont Blanc and of Mont Rose, which are comprised in the second and third of the Alpine zones of Lory, and referred to, in the recently published work of Dr. Diener on the Structure of the Western Alps, as the "Zone of the Briançonnais."

The author treats first of the stratigraphical succession of the region, and describes the grey lustrous schists, and the calcareous talcose schists, situated beneath the Triassic deposits, which have a great extension between Bardonnèche, Oulx, and Cezanne (Italy), as well as in the Queyras district. In the schists are beds of blackish crystalline limestone, also some quartzites, and in certain localities they are penetrated by numerous intrusions of serpentine. Near the source of the Ubaye these rocks gradually pass down into micaceous schists alternating with beds of gneiss. The lustrous schists were regarded by Lory as of Triassic age, but M. Kilian considers them to be Palæozoic, possibly Carboniferous, or even more ancient.

The Carboniferous rocks of the region form the great anticlinal of the third zone as well as some of the anticlinals of the second zone, and above them are beds of green phyllites, grits, and conglomerates, resembling the verrucano of the Swiss Alps, which from their stratigraphical position beneath the Trias are referred to the

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