branches. Whether geologist, palæontologist, mineralogist, petrologist, or mining expert, no one who pretends to do any work can afford to be without this publication, which, despite the faults of omission or commission usual in any work of the kind, is far and away the most valuable of any geological bibliography offered to the public.

The singular thing is that it should still remain unknown to many at home and abroad, for its low price (2*s*.) places it within reach of all. But as no attempt is made by the Society to advertise its existence, perhaps this is not to be wondered at. Some people seem to think that it is limited in its scope to those items received by the Geological Society; so it is, but the Society receives over 80 per cent. of the publications on the sciences it includes. The extraordinary value of the book lies in its index. Take one entry—"C. Reid, on the Geology of the country round Newquay, Mem. Geol. Survey, 1907." This is indexed under no less than fourteen heads, so that practically the whole contents of the memoir can be picked up under any special item. The same minuteness of indexing applies to the foreign literature.

It is undoubtedly the most valuable publication issued by the Geological Society of London, and will remain a standard work of reference as long as any geologist worthy the name interests himself in the subject.

CORRESPONDENCE.

THE GAVARNIE PROBLEM.

Sir,—Having only now seen Mr. Dixon's sections and conclusions, I can supplement them from observations repeated during the present year.

On Mr. Dixon's map the essentially continuous sheet of Hippurite limestone is figured as absent over two spaces each a kilometre in extent, and definable as the most easily accessible from Gavarnie. One of these is concealed by talus, but that at the mouth of the Ossoue valley gave me, in 1894, the following results of field and microscopic observation, repeatedly verified since that date. The supposed break is merely an extremely metamorphosed portion of the visibly continuous Cretaceous. It is penetrated throughout by numerous veins and bosses of microgranulite, undeniably proceeding from the underlying granitic basis. M. Bresson first admitted it to be pinched Cretaceous, but is now compelled to describe it as Palæozoic "by analogy of facies and by the established data of the age of granite." This analogy and these data led the last Director of the French Survey to map the Hippurite limestone as Cambrian over half the Pyrenees, and to denounce my maps and observations as "*a priori* inexact." Even M. Carez, M. Lacroix, and M. L. Bertrand admit them to be baseless. But M. Bresson is similarly compelled to figure the Caprina Cenomanien as Aptien at Sarrencolin and the Ordovician at Bagneres de Bigorre as Permian, and to describe the Cambrian of Jacquot as a masterly definition of the Devonian, although it was

defined as *beneath* the Silurian and although its types were selected from the heart of the Cretaceous. As at the valley of Ossoue, so at every point where limestone occurs in the Archæan basis of Mr. Dixon, there is a visible synclinal descent of the Cretaceous into the said basis. At Eaux Chaudes the same Hippurite limestone descends into the granite basis at the valley of Bitet, and is similarly penetrated by microgranulite; being especially metamorphosed at contact with intrusions of Porphyry, termed Andesite and Labradorite on the map, which porphyry traverses the main granitic mass, and is itself traversed by a white granulite common at Gavarnie beside the synclines of Cretaceous. To Mr. Dixon's classification of the Gavarnie basis as Archæan I have no objection, provided that, with many geologists, I may interpret such Archæan as an imperfectly cooked example of a magma that is frankly eruptive at other points. Certainly around Gavarnie this magma was so plastic as to permit the descent of thin sheets of Cretaceous to three hundred yards in depth, and to exhibit, at visible points of contact, the most distinctive features of irruptive intrusion. Around Eaux Chaudes vast portions of the Hippurite limestone are converted into white crystalline marble, irregularly mixed with ferruginous and dolomitic segregations. Their irregularity forbids their attribution to those dynamic influences which Sauer and others have controverted in the Alps of Glarus, where *augen gneiss* is as irruptive as at Gavarnie. Finally, at the Ossoue valley and elsewhere around Gavarnie, I have traced the constant presence of the 'Permian' of Pinede, passing insensibly into a peculiar gneiss crammed with ferruginous concretions. M. Bresson admits its presence in his latest papers. In the Pinede valley it is eaten into by the homogeneous granite, and reduced in places to a conglomerate of granitic basis.

One other point may be recommended, without offence, to future observers. South of Gavarnie the Spanish plateau is composed, for many miles, of that Flysch which I introduced and defined in 1881 as that of the Vienna basin. Over a thickness exceeding 2,000 feet it exhibits the Helminthoids, composition, and very peculiar structure of that formation. Between Torla and Faulo it overlies the Danien as regularly as throughout the Spanish Pyrenees. The denial of the possibility of its post-Danien age, and the denial of its association with gypsum and salt, form the basis of the 200 pages of the latest French Survey Bulletin by M. Leon Bertrand. Yet in Spain, as in France, it presents characteristic Nummulites, which are ignored as deliberately as my Hippurites of Eaux Chaudes in 1885. In three papers of the Biarritz Association I have invited verification of the facts. The peculiarity of this formation is its alternation of tranquil and violently contorted portions, and its abundant evidence of local volcanic action. Some of these have been recently verified by Professor Fournier. But the formula "*a priori* inexact" has been more popular than observation, and is confirmed in Mr. Dixon's conviction that my references to current Palæontology have no connection with matters wholly decided thereby. On Mr. Dixon's own map the extent of the supposed 'thrust-plane' can be measured as 8 kilometres, yet he adds 2 kilometres in

favour of his theory and resorts to microscopic evidence in its difficulties. The popularity of this method of settling problems which concern the roots of all geological reasoning is assured, if only the exclusive discussion of authors whose decisive sections are totally erroneous by their own testimony can be persistently maintained.

P. W. STUART-MENTEATH.

ST. JEAN DE LUZ.
September 15, 1908.

GLACIER GRAINS.

SIR,—I have pointed out[1] that in caves cut in the ice of glaciers, and also on the surfaces of glacier ice at high altitudes in places protected from the sun, the glacier grains are finely striated, the striations on different grains running in various directions. As each glacier grain is a distinct more or less strained crystal, it seemed advisable to determine whether the surface striations produced by evaporation bear any relationship to the crystalline structure of the ice grains.

Tyndall has pointed out that when, by means of a burning glass, the sun's rays are focussed in ice, liquid discs or flowers appear in the interior. These discs or flowers would, of course, be at right angles to the optic axis. I, therefore, last August, from the upper cave of the Rhone Glacier, cut samples of ice which showed these striations, and then by means of a burning glass produced the liquid discs within. In all cases these discs proved to be parallel with the external striations. One crystal in particular showed this very clearly. It was cut from a prism of ice and was striated on three sides. Not only were the striations on these faces in agreement, but the liquid discs produced by the sun's rays throughout the interior of the ice were in all cases in the same plane as the striations on the surfaces.

R. M. DEELEY.

THE OCCURRENCE OF FLINTS IN AN OLD GRAVEL-BED NEAR NEWBIGGIN-BY-THE-SEA (NORTHUMBERLAND COAST).

SIR, — Some years ago I first found flints in this deposit. Previously their presence had been unknown, and, so far as I am aware, nothing has since been published concerning them. The gravel-bed is of pre-Glacial age and lies upon sandstone of the Coal-measures, the only available section being that exposed in the cliffs between Newbiggin and the mouth of the River Wansbeck. Here it may be traced for a distance of 480 feet. At its northern boundary it is seen to rest against an ancient cliff running in a direction normal to the present sea-front, and at this point the gravel is over 18 feet thick, the total height of the cliff being 22 feet.

[1] GEOL. MAG., 1907, p. 529.