

Australian party, namely, Messrs. Baracchi, Cooke, Dodwell, Kenney, and Beattie, and Mr. Short for Worthington's party. This is the last post until after the eclipse. We will do our best to keep the flag flying on that eventful day, but we must have a clear sky.

W. J. S. LOCKYER.

N.B.—The photographs accompanying this letter were all taken (with one exception) by Mr. Winklemann. They were printed by a bluejacket on board H.M.S. *Encounter*, as conditions were not favourable for the process ashore. This bluejacket is a volunteer for our photographic department, and a very valuable one.

W. J. S. L.

### PHYSIOGRAPHIC STUDIES IN THE FRENCH ALPS.

THE former of the two memoirs included in the publication before us is a report by MM. Flusin and Bernard upon an apparatus for boring into a glacier, devised by MM. Hess and Blümcke, the working of which they had studied on the Hintereisferner in the Austrian Tirol. As the scientific interest of this is at present more indirect than direct, we may pass on to the second memoir, "Etudes Glaciaires Géographiques et Botaniques dans le Massif des Grandes Rousses," by MM. Flusin, Jacob, and Offner.

The Grandes Rousses is a rather lofty and insulated range in the French Alps, which rises on the right bank of the Romanche, roughly north-east of Bourg d'Oisans. On its jagged crest, which runs approximately from N.N.E. to S.S.W., two peaks, though some distance apart, attain the same altitude—11,395 feet. Its western side descends more abruptly than the eastern, so the glaciers on the former are shorter and steeper than on the other. It is an island ridge of crystalline rock—granites more or less gneissoid, and schists—rising from a hilly district of Lower Mesozoic (chiefly Liassic) rocks, mainly, no doubt, a result of the second of the two great folding processes which have given birth to the Alpine chain.

First in order, to the west of the watershed between France and Italy, is the great mass of crystalline peaks which rise around the headwaters of the Vénéon—two of them, the Ecrins and Meije, exceeding 13,000 feet in height—and are linked by the Col du Lautaret to the mountains south of the Arc. Farther west is the range of the Grandes Rousses, and still farther in that direction, separated by another syncline of Mesozoic rock, comes that of the Belledonne, the highest peak on which attains 9781 feet. The Ecrins *massif* is probably an extension (though perhaps not a simple one) of the Mont Blanc axis; the Grandes Rousses and the Belledonne, a prolongation of that of the Arguilles Rouges, which has either bifurcated or raised up another earth-wave in front. But the Grandes Rousses *massif* affords evidence of a much more ancient system of disturbances, for two strips of Carboniferous rocks (as may be seen in the valley of the Romanche) are sharply infolded in the crystalline series—just as occurs in the valley of the Rhone and on the way from Vernayaz to the Tête Noire. The author attributes this folding to the Hercynian movements, though its strike is much more nearly north and south than east and west. It was, at any rate, succeeded by enormous denudation, for in this part of the Alps the base of the Mesozoic series may be seen resting on the denuded edges of these huge folds.

The report includes a study of the Alpine plants in the three regions or stages into which the range may be divided, and a very full account of the snowfields and glaciers. The snow-line, of course, varies in different localities, but the authors take 8720 feet as an average, which very nearly coincides with the limit of the *névé*, that is, where ablation balances accumulation, or expenditure just exhausts income in the matter of snow. This limit, they point out, rises as the altitude of a group increases, being about 650 feet higher in the Grandes Rousses than in the Belledonne, while in the eastern

<sup>1</sup> Ministère de l'Agriculture—Direction de L'Hydraulique et de Améliorations Agricoles—Service d'Etudes des Grandes Forces Hydrauliques (Région des Alpes)—Etudes Glaciologiques. Tirol Autrichien. Massif des Grandes Rousses. Pp. vi+112 + ix plates + ix panorama views (1909).

*massif* it overtops the former by 400 or 500 feet, a result which seems to call for explanation. Particulars also of the retreat of the glaciers are given, with maps and some interesting photographs; in short, the memoir is a most elaborate one, though we cannot forbear remarking that if a similar exhaustive treatment is applied to other parts of the Alps—and the practice seems to be growing—conscientious students will before long often have to choose between hours in a library and work in the field.

T. G. B.

### THE MOVEMENT OF SUBSOIL WATER.<sup>1</sup>

IN all densely populated areas the water supply is a matter of primary importance, especially where the rainfall is scanty, and where a large proportion of the supply is derived from shallow wells. Dr. W. F. Smeeth, of the Geological Department of Mysore, has prepared a report dealing with this subject, which is based upon observations made during the year 1909, so that it provides rather a basis for further study than a complete discussion of the subject. The Mysore plateau extends over some 29,400 square miles, and is composed almost entirely of gneisses, granites, and crystalline schists, which are more or less decomposed to a depth of from 50 to in some places as much as 100 feet; the upper 50 feet of this forms a reservoir which is fed by the rainfall, and will hold a quantity of water varying with the porosity of the materials, and from it the wells derive their supply. On account of the seasonal character of the rainfall the level of the water-table varies considerably, and from various considerations the author takes a zone of intermittent saturation having a mean depth of 10 feet, and an average porosity of 12 per cent., as representing the average conditions which occur.

The rainfall varies greatly, from 73.21 inches in the west to 21.27 inches in the east of the area, and from the average variation of the water-level in wells, compared with a ground water supply which is taken as equal to 10 per cent. of the variation in the water level in each district, a "percolation factor" is obtained. No river discharges are included, nor is evaporation determined in order to obtain an independent value of the amount accounted for by percolation, which by the method employed is given as from 19.9 to 66.7 per cent. of the average rainfall. The rainfall also differs considerably in type in different portions of the area, having a strongly marked maximum in July due to the south-west monsoon in the west, while in the east the rainfall of the north-east monsoon in September and October is more important.

Observations were collected so far as possible from all villages, and 2563 wells were recorded from which fairly representative deductions for the year under investigation were possible. The mean depth of the water from the surface varied from about 38 to 4 feet, the mean values for maximum and minimum depths being 30 and 18, while the mean variation in the course of the year was 12.4 feet, and 37.5 per cent. of the wells were reported as drying up during the year. The variations of level ranged from an average of 15.3 feet for shallow wells in which the minimum depth to water-level was under 10 feet, to 8.2 feet in those where it was over 40 feet. Details of the water met with in the Mysore mines is included, but not much is deducible from such information at present. A series of diagrams show the position of the maximum and minimum water-levels in the village wells observed, and it is clear that a large number of them do not reach the depressed water-table of the dry season, since the conditions are not realised by the well owners. Deeper and fewer wells are recommended with pumping where necessary, and a systematic distribution of the permanent supply so obtained. Further investigation is recommended for the seasonal variation of water-level in different districts has not been considered. While diagrams are abundant, maps of the region, whether topographical, orographical, or showing the distribution of the rainfall, are conspicuous by their absence, and render a satisfactory study of the report difficult.

Although the Nile and its system of canals provide most

<sup>1</sup> "Notes on the Underground Water Resources in Mysore." By Dr. W. F. Smeeth. Pp. 69, plates 1-69. (Government Press, 1911.)