

like Mr. Ashburner's with the coal contours in red, complicated as they sometimes are with overturned dips, might besides advantageously have surface contours in rather fine black lines, or in some other colour.

NORTHAMPTON, MASS.

NOTICES OF MEMOIRS.

DIE EISZEIT IN DEN PYRENÄEN. VON DR. ALBRECHT PENCK. Mit einer Karte. Mittheilungen des Vereins für Erdkunde zu Leipzig, 1883.

THE GLACIAL PERIOD IN THE PYRENEES. By Dr. ALBRECHT PENCK. With a Map. (Transactions of the Geographical Society of Leipzig, 1883.)

THIS paper contains the general results of an investigation of the ancient glacial phenomena of the Western Pyrenees, from San Sebastian on the Atlantic coast to Montrejean on the Garonne, undertaken with the object, amongst others, of determining the approximate level of permanent snow at the time of the greatest extension of the glaciers. Of this, the author's previous experiences in the Alps, Scandinavia and Great Britain render him well fitted to judge. He incidentally remarks that the similarity between the glacial phenomena of the Pyrenees and those of the countries just named are very striking.

It has been stated by various authors, amongst others by Habenicht and von Hochstetter, that the valleys of the western end of the Pyrenees had been formerly filled by ice; but Dr. Penck asserts that there is not a trace of glaciation in the valleys of the affluents of the Bidassoa, the Nive, and the Urumea, although the indentations of the coast near San Sebastian and Fuenterrabia have a distant resemblance to fiords. Although the highest peaks in this district reach an elevation of 1400 m. (4600 feet), there are neither cirques, tarns, nor moraines to be found, and their absence proves that in this locality the line of permanent snow (Firnlinie) during the Glacial period was at all events above this level. It is true that in places there are huge boulders and scratched stones which have been attributed to glaciers, but their distribution is very limited, and they may be traced to the effects of landslips.

The valley of the Saison is the most westerly on the French side of the range in which glacial action appears. The average elevation of the mountains which drain into it is 1740 m. (5707 feet), and the old moraines can be traced to the level of 581 m. (1905 feet). In the valley of the Aspe, to the east of the Saison, a moraine exists at the level of 410 m. (1344 feet), and below this is a distinct basin now filled up with gravels. Further eastwards, in the valley of the Ossau, a terminal moraine has been noted at 350 m. (1148 feet), but even below this level, scratched stones and moraines have been noted, so that in the Pyrenees, as in the Alps, there is an outer zone of moraines distinct from the so-termed end-moraine, and a great accumulation of gravels was formed in the interval between the deposition of the outer moraines and the later end-moraine.

Further to the eastward the important glaciers of the valley of Argelès and of Aure are described, and then the glaciers of the Garonne, the most important of the Pyrenees. The portion of the range drained through this valley has an average elevation of 2560 m. (8400 feet). From the evidences of the ice action in the higher districts of the Garonne, the conclusion is arrived at that the line of permanent snow in the Glacial period was about 1700 m. (5576 feet).

On the south side of the Pyrenees the author describes the course of two of the ancient ice-streams; that of the valley of the Gallego, which had a length of 45 kilom., and that of the Ara valley 40 kilom. in length. These correspond with the glaciers of Ossau and Argelès on the north side, which have respectively an extension of 40 and 55 kilom., but whereas these latter advance beyond the foot of the mountains to the level of 400 m. (1312 feet), the former, on the south side, do not descend below 800 m. (2624 feet).

The ancient glaciers on the south side of the Pyrenees, not only terminated at a higher level, but they were also far shorter than those on the north side, and these differences arise, not from the configuration of the ground, but in the different intensity of the glacial phenomena on the two sides. It is therefore probable that the ancient snow-line on the south side was 300 m. higher than on the north, or at a level of 2000 m. (6560 feet). The ancient snow-line was also higher from west to east, and the evidence shows that the ancient phenomena were developed under similar conditions to those now existent, and may be considered as an intensification of the present.

Sections showing glacial deposits of different periods do not occur in the Pyrenees, as almost everywhere the moraines rest directly on the older rocks, but indirect evidence of more than a single glaciation is shown by the enormous accumulations of gravels, clearly of different ages, which cover the surface beyond the base of the mountains on the north side, sometimes reaching a thickness of over 100m. (328 ft.).

The concluding part of this important paper contains some suggestive reflections on the development of the cirques and smaller lakes in the higher portion of the Pyrenees and their relations to each other. A list of the directions of the glacial striæ observed by the author is given in an appendix; and a map of the Pyrenean range and the country on both sides, in which the glaciated areas are distinctively coloured, is of great service in following the author's descriptions.

G. J. H.

REPORTS AND PROCEEDINGS.

I.—GEOLOGICAL SOCIETY OF LONDON.

January 28, 1885.—Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., President, in the Chair. The following communications were read:

1. "The Boulder-clays of Lincolnshire: their Geographical Range and Relative Age." By A. J. Jukes-Browne, Esq., B.A., F.G.S.

The author commenced by referring to the late Mr. Searles V.