NOTICES OF MEMOIRS.

I.—On the Discovery of Actual Glaciers on the Mountains of the Pacific Slope. By Clarence King, U.S. Geologist.

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THE researches of the last ten years in the extreme height of the mountains of the far west of the United States has shown the remarkable feature, on the one hand, of the absence of glaciers in situations which in altitude and configuration resemble the glacier regions of Switzerland and Norway, and on the other, especially in the higher Cordillera, of the ancient presence of glaciers in the form of modified surface configurations, vast moraines flanking the upper gorges, roches moutonnées, and polished rocks, at various levels above 9,000 feet. The researches of Prof. Whitney and his assistants in the Sierra Nevada have developed a glacier system as extensive and as vast as that once occupying the valleys of the Alps, but, unlike it at the present day, no traces of glaciers are to be met with in the Sierras, save one or two rudimentary masses of ice, and the fields of perpetual névé. This snow, though deep and extensive, is not sufficient to initiate glaciers, the whole region being traversed by a west wind, the moisture of which is wrung from it by warm ascending currents from the valleys below, and there is not sufficient left to cause any great precipitation on the mountain peaks; thus the heights of Colorado are less snowy than those of the Sierras, and the Wind River, Wahsatch and Uintah ranges, were found by Mr. King to be even less than the Laramie range in Colorado.

In September, 1870, Mr. King, "with a small detachment of the U.S. Geological Exploration of the 40th parallel," visited Mount Shasta, Northern California, to make a detailed survey of the lava systems which flow east from the peak, and are connected with the basalt of the Desert of Nevada.

Between the main mass of Shasta and the secondary conical cone (the lesser Shasta), occurs a deep gorge, through which flows a glacier curving round the base of the latter, its width there being about 4,000 feet, and not less than three miles of it being in view, starting almost at the crest of the main mountain, the top of which was found to be 14,440 feet above the sea-level. From this crest three glaciers were seen, one being four miles and a half in length, and from two to three in width. On the south side no glaciers or even snow occurred, which accounts for Prof. Whitney's party failing to find glaciers on this mountain, an east and west line dividing the tract with glaciers from the tract without.

Small masses of ice were found on the shaded side of many of the deep ravines or cañons which intersect the lava flows, some of these masses being from one to two thousand feet in length; one larger one occurred in a deep cañon on the eastern side of the volcano, being divided into two branches by an uprising dome of lava, the one extending for a mile and a half down the cañon, the surface being

nearly covered by the falls of stone from the walls or cliffs, the ice being only seen where the stones have found their way in, or through the glacier, the other branch being abruptly terminated by a rounded bluff 900 feet in height. A larger glacier occurs on the north-east slope, and a still larger on the northern; this latter covers the slope for four miles in breadth, and sub-dividing into many smaller streams on reaching the cañons below, where it is believed to be not less than 1,800 to 2,500 feet thick, and traversed by crevasses 2,000 long by 30, and even 50 feet in width.

With the exception of thin sharp edges of lava projecting upwards above the general level, the whole northern face is one vast body of ice, which is traversed by streams which pour into wide crevasses, and which flow out milky with suspended sand at the lower ends. Here the whole face of the ice is covered with sheets of *angular débris*, but neither moulines nor dirt bands were observed. On the snowless side of the mountain, at a height of 8,000 feet, a great terrace occurs, nearly 3,000 feet in width, entirely composed of moraine matter.

In a letter to Mr. King, Mr. S. F. Emmons, Assistant Geologist, describes the glaciers of Mount Tachoma or Rainier, which form the source of four rivers in Washington Territory. The summit of Tachoma he describes as consisting of three peaks, the eastern being the highest, separated from the others by deep valleys; it is a circular crater, a quarter of a mile in diameter, bare to a depth of 60 feet below the rim, below which, down to 2,000 feet, the mountain slopes are covered with an immense sheet of white granular ice, broken by a few long transverse crevasses; below this it is divided up by projecting rock ridges into ice cascades for 3,000 feet, at angles almost approaching the perpendicular; from the foot flow true glaciers, sinking deeper, becoming narrower, and exhibiting smaller angles as they descend.

The Nisqually, the narrowest of the three main glaciers, is traversed at its lower end by longitudinal and horizontal crevasses, where it passes over unyielding unconformable syenite; walls of lava, 1,000 to 1,500 feet, rise as precipices above the surface of the ice. But in the Cowlitz glacier the slopes above are not so steep, and are occasionally covered with the *Pinus flexilis* and the mountain fir, the former growing as high as 2,000 feet above the mouth of the glacier.

The largest glacier of all is that of the White River, which flows out of the crater, extending at least ten miles, being five miles broad on the mountain, and a mile and a half below. It appears to have eroded and cut away not *less than* a third of the mass of the mountain, the thickness of rock removed being not less than a mile. It has two principal medial moraines, which form ridges, with peaks nearly 100 feet high. It is divided in two at the foot of the slope by a rocky ridge, at the back of which a secondary glacier has scooped out a basin-shaped bed.

In a report to Mr. King, Mr. Arnold Hague, Assistant Geologist, describes the extinct volcano of Mount Hood, in the Cascade range of Oregon, on the southern slope of which he found three distinct

glaciers flowing out of a basin of ice and snow, filling the crater, which is nearly half a mile in width. In these glaciers, which are known as those of White, Sandy, and Little Sandy Rivers, there are numerous marginal crevasses, ice caves and caverns, and fine examples of veined and laminated structure in ice, glacial groovings, and boulders. The White River glacier descends 500 feet below the level of timber trees upon the slopes of the mountains.

Around Mount Hood are the remnants of far more extensive glaciation, which has cut trough-shaped valleys in the earlier trachytic lava flows of the volcano.

This important paper is not only interesting for the light which it throws upon the past and present glaciations of this old volcanic region of Northern California, but as throwing light on that of the English Lake District and Welsh Mountains, showing how it is possible for ice to entirely cover the mountains above, without filling up hill and valley below. C. E. De Rance.

II.—Journal of the Royal Agricultural Society of England. Second Series. Vol. VII. Part I. 1871.

THREE papers in this number of the Agricultural Society's Journal command our attention. (1). Mr. Jenkins, F.G.S., reports on some features of Scottish agriculture, paying particular attention to the subjects of Lowland farming, Dairy-farming, Aberdeenshire cattle-feeding, Highland sheep-farming, and West Highland cattle-breeding. The subject of Lowland farming, including arable farming in the East and West of Scotland, has been illustrated with an account of four Lowland farms. The geology of the farms is briefly noticed. On one a rich red loam, derived from the Old Red Sandstone is endowed with great natural fertility; on another the soil generally rests on interbedded felstone, but in parts intrusive greenstone or columnar basalt comes to the surface; there is also a blowing sand, certainly an ungrateful soil, for the crops are liable to be blown away. The description of these farms shows the various methods by which good crops may be produced under different circumstances, whether by good land, good cultivation, or liberal manuring.

(2). The agricultural capabilities of the New Forest form the subject of a paper by Mr. W. C. Spooner. This tract of land comprises from 63,000 to 66,000 acres in the south-west of Hampshire; formerly indeed it was far greater, for in Domesday Book its extent is given as no less than 147,200 acres. So favourable is its aspect, that were its soil equally good, the most sanguine expectations of its future productiveness would be realized. The sub-soil, however, ranges from a retentive clay to the most arid sand, and the surface-soil, never very deep, varies from a few inches of the poorest material to 6 or 8 inches of hazel loam. The geological formations represented belong to the Middle and Upper Eocene groups, and these have been described in an article incorporated with this paper,

by Mr. T. Codrington, F.G.S., etc.[1] They include the Headon Beds, the Upper Bagshot Beds, the Barton, Bracklesham, and Lower Bagshot Beds. Overlying these formations is a sheet of flint-gravel, which varies from 2 feet to 6 or 8 feet in thickness, and extends over the open plains and heaths of the Forest, covering about a third of the district. The Headon Beds, consisting of clays and marls, afford some of the best land in the Forest. In regard to the cultivation of the Forest, Mr. Spooner conjectures that not less than 20,000 acres would be found to repay the expense of tillage, for there are great facilities for ameliorating the land by means of marl and chalk.

(3). The Comparative Agriculture of England and Wales is treated of by Mr. W. Topley, F.G.S., of the Geological Survey of England. In order to obtain some accurate knowledge of the distribution of crops, with the view of comparing them with the physical structure of the country, Mr. Topley has calculated the percentage of acreage devoted to each. A table accompanying his paper shows the percentage of each crop to the total acreage of each county in England and Wales. He remarks that in trying to classify the English counties according to their leading physical features, we find that the western part of the country contains the largest portion of high land, and that this higher western land is occupied by the older geological formations. A map of rainfall and temperature shows that the greatest fall is over the western high lands; and, speaking generally, over other districts the fall is in proportion to the height of the ground. Summer temperature is of great importance; this is highest over the eastern central district. Considered agriculturally, we find that the western counties are characterized by their large acreage of grazing land, whilst in the eastern there is a high percentage of corn land. There is thus a general coincidence between geological structure, contour, climate, and agricultural products. These four classes of facts are of importance in the order here given; each is controlled by the one that precedes it. Agriculture depends mainly on climate, climate mainly on contour, and contour mainly on geological structure.

Mr. Topley's paper is deserving of careful study by all those who are interested in agricultural geology.

REVIEWS.

I.—Geological Survey of India—"Annual Report" and "Records."

THE progress of British Systematic Geological inquiry being important, we are glad to observe that the close of the financial year brings with it the Report of the Geological Survey of India, occupying the first fifteen pages of the Records of that Survey for 1871; and although Indian affairs short of a political catastrophe are said to excite but little interest here, this Indian Survey Report will

[1] Mr. Codrington has also laid down the geology of the New Forest on an admirable chromo-lithographic map accompanying this paper.