GEOLOGICAL WORK IN CANADA AND AUSTRALASIA.

THE Geological Survey of Canada publishes in Memoir 72 an account of "The Artesian Wells of Montreal," which is suggestive to investigators in other limestone districts. Out of 179 deep wells, only about twenty yield less than 5000 gallons a day. The water usually comes in greatest abundance from depths of 300 to 1000 ft., and rises to within 30 ft. of the surface. The chance of finding a good supply below 1000 ft. is small, and it seems that the source of the water (p. 26) is the rain that falls on the St. Lawrence highlands and lowlands and creeps into the Palæozoic sediments. This water moves in the limestone along fissures and cracks, and is held up at no particular horizon; the closing of the fissures as the depth increases is held to explain its practical absence below 1000 ft. The author, C. L. Cumming, discusses the origin and possible interactions of the dissolved salts; the proportion of sodium carbonate is high for water in sedimentary deposits (p. 48), and this salt may be derived from flow over the crystalline rocks of the Laurentian highlands.

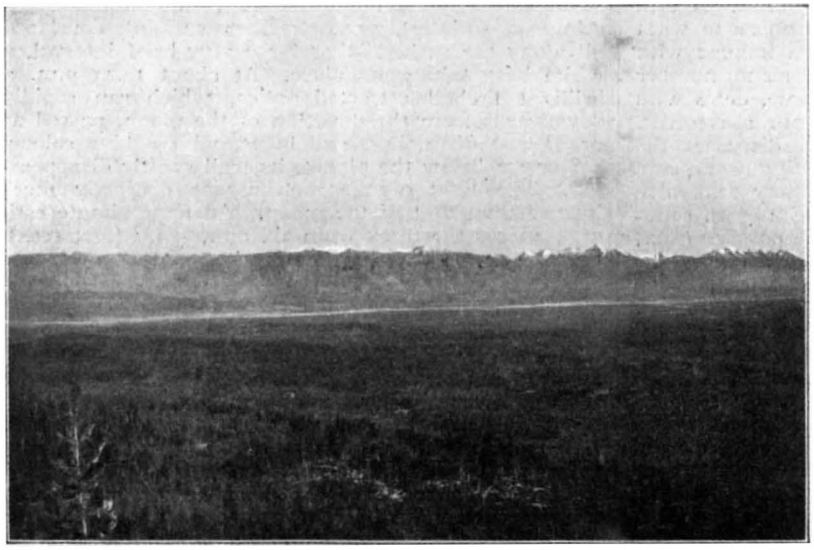

FIG. 1.—The Rocky Mountain Trench, looking east across the Kootenay River near Cranbrook, B.C. From "Geology of Cranbrook Map-Area, British Columbia."

Four considerable memoirs deal with districts in British Columbia, and are accompanied by geological maps conveniently folded in pockets at the end. Memoir 55, by J. A. Allan, on the "Geology of Field Map-area, B.C. and Alberta," covers the mountainous district on the west slope of the Rocky Mountains, where Mt. Goodsir rises to 11,676 ft., with esidual glaciers on its steep north-east descent. One of the most famous stretches of the Canadian Pacific Railway lies within the area, and the continuous Cambrian section studied by Dr. C. D. Walcott in recent years occurs on Mt. Bosworth, in the north-east corner of the map. A mass of igneous rocks rich in alkalies was intruded through the older Palæozoic strata in post-Cretaceous times, and has been cut into by the valley of the Ice River. The richness of the prevalent nepheline-syenite in lime is attributed (p. 186) to its absorption of limestone at the contact-zone. The author points out (p. 42) the necessity for distinguishing cirques formed by local excavation at high levels, by the action of Russell's "mountain-side" type of glacier, from those left behind as hanging valleys. This distinction is even now worthy of emphasis, although Matthes's work on "nivation" in the Bighorn Mountains has justly attracted attention.

Toxada Island, the elongated and steeply flanked ridge that rises from the Strait of Georgia, north-west of Vancouver, is described by R. G. McConnell (Memoir 58) The main rock is a great body of porphyrite of Lower Jurassic age, which shows pillow-structure (plates iv. and v.), here called nodular structure, though it seems to be an intrusive mass. Magnetite lenses, which sometimes form low hills, have encouraged mining. They are held to be contact-products (p. 77), connected with the younger intrusive rocks, which are in part of Lower Cretaceous age.

The Cranbrook map-area has been studied by S. J. Schofield (Memoir 76), on account of the development of gold-mining in lodes in the eastern part of the Kootenay electoral division. The district is well served by railways, which connect it southward with Montana, and northward with the main Canadian highway west of Field. It includes the south end of the "Rocky Mountain Trench" (p. 10), which extends to the borders of Alaska. In this tectonic feature the Kootenay River runs southward, amid parklike and largely alluvial country, while deeply dissected mountains of pre-Cambrian sediments rise beyond Cranbrook on the west. The Rocky Mountains on the east present the appearance of a distinct range, their crests of remarkably even altitude being touched here and there with snow (Fig. 1). The composite Purcell sills (p. 75), with upper zones of micropegmatitic granite and lower gravitational zones of gabbro, have much interest for petrographers.

The singular course of the Kootenay River brings it round the Purcell Range again into British Columbia, along the flooded valley known as Kootenay Lake, and westward out of this hollow to join, and largely to form, the rapid Columbia River descending on Washington and Oregon. Rossland (Memoir 77) lies on the upper part of the Columbia, close to the International Boundary, which cares for none of the things of physical geography. The alpine landscapes here lie away upon the east, and the town has grown up in the last twenty-five years among glacially moulded and often wooded hills. From its sulphide ores the output of copper rose to a maximum in 1902. Gold is extracted from massive pyrrhotine and copper pyrites, in which it is occasionally visible in a free form. C. W. Drysdale, in this memoir of 317 pages, deals with mining matters first. The ores made their appearance (p. 92) in fissures in connection with the intrusive rocks of the Jurassic mountain-building stage, and secondary enrichment, including the rise of gold, occurred during the Miocene disturbances. The author inclines (p. 186) towards a "three-cycle hypothesis" of the development of the surface-features around Rossland, beginning with the dissection of the Cretaceous peneplane, of which very few traces now remain. The Laramide upheavals were the cause of this dissection, which continued through Eocene times. Movements in the Oligocene period led to the destruction of much of the Eocene deposits by renewed erosion; and then Miocene diastrophism, accompanied by the introduction of mineral ores, provided a surface in which broad fairly mature features were established by the close of the Pliocene period. Renewed upwarp-

ing started the present cycle, which includes the modifying erosion of the Glacial epoch. The author's treatment involves some repetition from the sketch on pp. 41–43 to the final chapter on geological history (p. 244). His views are opposed to R. A. Daly's broad conception of the Purcell and Rocky Mountain ranges as derived from the continuous dissection of the folded Laramide mass. The scenery, whether of mines or mountains, the rocks and minerals, and even the useful cores obtained from prospecting bore-holes, are well and fully illustrated.

In a paper on the "Nephelite Syenites of Haliburton County, Ontario" (Amer. Journ. Sci., vol. xl., p. 413), W. G. Foye gives reasons for believing that the syenites rich in alkalies arose in the invading granite magma in consequence of the interactions which converted the local limestone into amphibolite. The production of calcium silicates set free solutions richer in sodium than the invading granite, and these in places modified the granite mass. The field evidence adduced thus supports R. A. Daly's theory of the origin of nepheline-bearing rocks.

From Australasia we receive E. C. Saint-Smith's report on the Stanthorpe district of S. Queensland (Queensland Geol. Surv., Publication No. 243). The granites of the region show the characteristic "bouldery" weathering associated with tropical sunlight and clear starry nights. These granites and the finely grained more acid types that cut them have brought up cassiterite, wolfram, and molybdenite. The intrusion is possibly of Mesozoic age. In Publication No. 249 L. C. Ball gives a cautious description of the "Oil Shales in the Port Curtis District," where fireclays may prove to be an important asset.

E. C. Andrews (New South Wales Geol. Surv., Mineral Resources, No. 18) regards the copper lodes of the Canbelego district (p. 63) as connected with Silurian or even older earth-movements. He reports in detail on the mines, which are associated with those of the Cobar copper- and gold-field, and lie up-country more than 300 miles north-west of Sydney. On p. 62 cerussite has by an accident become included in the oxides.

R. L. Jack, with the aid of a team of camels, has explored a region between the Musgrave Ranges and the 28th parallel of latitude in South Australia (Geol. Surv. South Australia, Bulletin No. 5), and reports that the country could rear stock if a trustworthy water-supply could be obtained. He advocates (p. 35) the sinking of further wells; but the forethought required in undertaking such work is shown in the necessity for choosing "a good season, when water is obtainable to enable the first wells to be sunk." The memoir, in addition to geological data, contains papers on the flora and on magnetic observations. The Government astronomer, G. F. Dodwell, contributes maps showing the magnetic declination, inclination, and horizontal intensity in South Australia.

Bulletin No. 61 of the Geological Survey of Western Australia, by J. T. Jutson (price 2*s.* 6*d.*), is a volume for geographical libraries and for any general reader interested in colonial progress. Its title, "An Outline of the Physiographical Geology (Physiography) of Western Australia," is well borne out in its systematically written chapters. Numerous maps and landscapes illustrate the surface-features and the flora. The tropical weathering and the arid condition of the interior will impress scholars in our islands, and the memoir may well be used by those who wish to illustrate geographical principles by a new and unhackneyed field. H. P. Woodward's "Geological Reconnaissance of a Portion of the Murchison Goldfield" (Bull. 57) is of equal interest through its excellent illustrations of the country, several of which reappear in Jutson's memoir. We are thus able to realise sheet-denudation caused by sudden rains falling on dry surfaces, laterite caps on crumbling desert hills, and water-holes of dubious character. The holes mentioned on p. 35 have a palæontological interest, since they were found, on being "cleaned out," to be full of dead kangaroos, thus serving as an example of the localisation of such remains in arid lands. Students of prehistoric man will note the valuable and fully illustrated account (pp. 74-89) of the native red-ochre mine at Wilgie Mia, where initiated medicine-men worked the pigment and developed a valuable trade (Fig. 2). The association of the ochre with legendary blood-stains (p. 88) may be compared with the story of the origin of the hæmatite veins on the face of Slieve Gallion in Co. Londonderry.

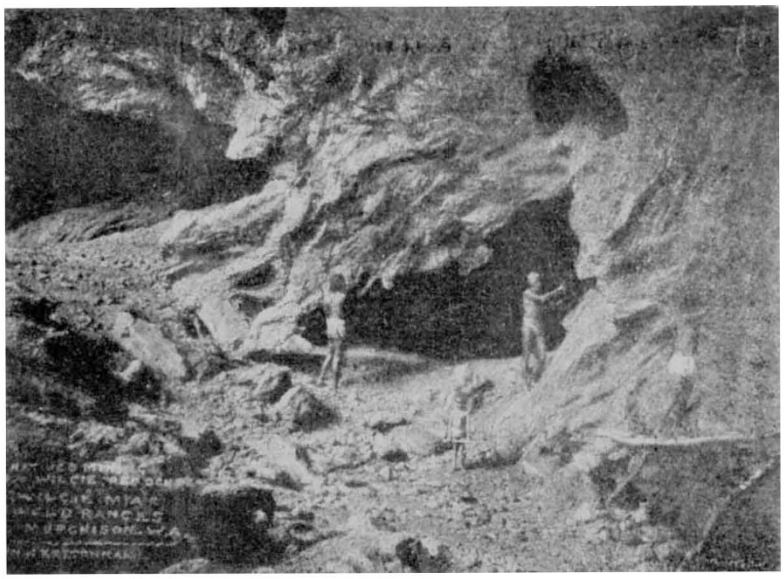

FIG. 2.—Natives working red ochre at the cave of Wilgie Mia, Western Australia, with the aid of timber staging. From "Geological Reconnaissance of the Murchison Goldfield."

The New Zealand Geological Survey, now under the direction of P. G. Morgan, has issued Bulletin No. 17, on the Buller-Mokihinui sub-division, a district on the coast of Westport. Despite preliminary difficulties of access, and in a district of deep gorges and high rainfall, a large industry has been established in bituminous coals that were formed in Eocene lakes. One seam on Magatini Creek is 54 ft. thick, and the authors, P. G. Morgan and J. A. Bartrum, write (p. 155): "The numerous magnificent outcrops of clean, almost ashless, hard coal in this locality cannot fail to arouse enthusiasm in the spectator." This shows the right spirit; and the volume also reveals the impression made by beautiful river-scenery. The word *Gräben* for *Graben* occurs in several places; we cannot be too careful when importing such words into our geographical nomenclature, and we have recently noted the strange form *ösar* nearer home.

G. A. J. C.