

CANADIAN GLACIERS.¹

IN Dr. Sherzer's elaborate memoir on five glaciers in the Canadian Cordillera, we have a contribution to the study of ice-streams not less important than that recently undertaken by the Indian

abolished in one name and retained in the other we fail to understand) rain and rivers were the chief sculpturing agents, but with the latter, ice began to make its mark on the rocks. There was, in fact, a Glacial epoch here as well as in the European Alps, and Dr. Sherzer tells us that signs are found of two, and one case of three, advances of the ice, followed by retreats. We should have welcomed a rather more precise description of the materials deposited on these occasions than is conveyed by the terms "till" and "ground moraine," because the identification of the latter is often, as we know from experience, a function of the writer's imagination, but we infer that in this case the deposits alter in character as the distance from the present ends of the glaciers increases, much as they do in the Alps of Europe.

In the case of each glacier, very careful observations have been made on the present position of its end, the signs of advance or retreat, the nature and quantity of moraine, and the structure and other physical properties of the ice. No one of them is really large, the Victoria, of which the fullest description is given, not exceeding more than about three miles in length. Starting at Abbot's Pass

(about 9500 feet) on the divide, its ice emerges from beneath the snow about 2000 feet lower down, and melts away after descending about 1500 feet more. According to the description,



Photo.

FIG. 1.—Illecillewaet Glacier in 1888. *Notman and Son, Montreal.*

Geological Survey, which was recently noticed in these columns (p. 201). Easy of access, and thus well adapted for study, these Canadian glaciers lie between the 51st and 52nd parallel, that is to say, very nearly on the latitude of London; two of them, the Victoria and the Wenchemna, being east of the continental divide, the third, the Yoho, west of it, while the Illecillewaet and the Asulkan glaciers are in the Selkirks. The peaks of each range often vary from ten to eleven thousand feet in elevation, rarely exceeding the latter, and though they form rather more continuous walls and exhibit less contorted strata, remind us of the Swiss Oberland, west of the Kanderthal. The ranges, in fact, are carved out of stratified rocks, the deposition of which began quite early in the Cambrian period (the crystalline Archæan floor being invisible in this region) and continued through Palæozoic and Mesozoic ages until the end of the Laramie. Then this enormous mass of sediment, supposed to measure from ten to twelve miles in thickness, was slowly bent up into a very broad and flattened arch—designated, inappropriately as we think, by the modern mongrel term, a peneplain—which was duly carved into peak and valley by the ordinary forces of subaerial erosion. Through Cenozoic (*sic*) ages until the beginning of the Pleistocene (why the diphthong should be



FIG. 2.—Illecillewaet Glacier in 1905, from approximately the same view-point as Fig. 1.

it exhibits all the features usual in an Alpine glacier—crevasses, moulins, stratification, blue bands, shear planes, a granular structure, and sometimes even the disputed capillary tubes. Observations were made to determine the rate of movement, which, if

¹ "Glaciers of the Canadian Rockies and Selkirks (Smithsonian Expedition of 1904)." By Dr. William Hittell Sherzer. Pp. xii+135. (Washington: Smithsonian Institution, 1907.)

these be confirmed, is unusually slow, a maximum of 65 feet a year.

The Wenkchemna receives the name of a Piedmont glacier, rather on the Bottom's dream principle, for, though formed by the lateral union of several short ice-streams (called "commensal" because they are fed from different sources), they come to an end high up in a mountain valley. The Yoho glacier, on the west side of the divide, is split into two by a rocky rib at its lower end, and is unusually free from surface débris. The Illecillewaet glacier, best known of those in the Selkirks, with its steep cascade of shattered *séracs*, forms an imposing feature in the landscape, but, as a comparison of the accompanying figures plainly shows, retreated considerably between 1888 and 1905. The Asulkan glacier is the smallest and most southern of the five, but is nevertheless a fine object.

Lakets, moraines, and other "leavings" of the ice show that all these glaciers have retreated in comparatively recent times, but more facts must be gathered before the periodicity of their movements can be ascertained. It is, however, as Dr. Sherzer points out, not unlikely to agree with the approximate thirty-five and a half years already inferred for other districts, and we may notice in passing that in these mountains the "Chinook" wind is a substitute for the Alpine "Föhn." He claims for glaciers a certain amount of erosive action—the scooping out of small lake-basins in favourable circumstances, and the conversion of valleys in their lower parts from V-shaped into U-shaped. The latter may be; but we cannot help remarking that in the Alps, where the ice at equal distances can hardly have been less in quantity, it seems to have been singularly incapable of effacing any pre-existent feature of importance. Dr. Sherzer also claims that ice can exercise a plucking action, but apparently only when passing over a much-jointed quartzite. Obviously, this would be the worst possible material for making *roches moutonnées*, but even here we should like a little more proof that the glacier has mastered the "art of pluck."

The so-called "bear den" moraines—piles of coarse broken rock without the usual infilling of fine material—seem to be one of the more exceptional features of this region. Dr. Sherzer regards them as records of "landslides" upon the ice from the higher peaks. That would explain their structure, but we doubt whether an earthquake is needed to start a "berg fall." Not to mention earlier instances, those near Elm in the Sernfthal and from Turtle mountain in Alberta occurred without any seismic disturbance. The prismatic structure in "ice dykes" is also remarkable, and recalls that exhibited in *glacières* and pond-ice—a subject once much discussed, among other places, in the first and second volumes of NATURE. On the whole, though sometimes, perhaps, a little too diffuse in describing the well-known, Dr. Sherzer has made a valuable and remarkably well-illustrated contribution to the literature of glaciers.

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THE FORTHCOMING MATHEMATICAL CONGRESS AT ROME.

AS was announced in NATURE for February 6, the fourth International Congress of Mathematicians will be held at Rome in the week before Easter. The congress meets once every four years, the previous places of meeting being Zürich, Paris, and Heidelberg. On this occasion the order of proceedings will be as follows:—

Sunday, April 5; Reception at the Aula Magna by

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the principal of the University, at 9.30 p.m. Monday, April 6: Inaugural meeting at 10 a.m. at the Capitol, at which Prof. Volterra will read a discourse on Italian mathematics in the last half of the nineteenth century. At 3 p.m. a general meeting will be held at the Reale Accademia dei Lincei for the election of a president and for the award of the Guccia medal, followed by two lectures. From Tuesday, April 7, to Saturday, April 11, the congress will meet in four sections every morning at 9 a.m., the subjects of the sections being (1) arithmetic, algebra, and analysis; (2) geometry; (3) applied mathematics; (4) philosophy, history, and teaching of mathematics. In the section of applied mathematics the subject of actuarial mathematics will be introduced by Prof. Toja for the first time at these congresses. On each of the afternoons of April 7, 8, and 10, two lectures will be given, commencing at 3.30 p.m. Thursday, April 9: Visit to the Palatine by invitation of the Minister of Public Instruction, at 3 p.m. Saturday, April 11: Concluding general meeting; arrangements for date and place of next congress. Ninth and tenth lectures. Sunday, April 12: Visit to Hadrian's villa and lunch at Tivoli.

In addition, a reception will be given by the municipality in the museum of the Capitol on some evening during the week.

The lectures arranged are as follows:—Darboux (infinitesimal geometry), Forsyth (partial differential equations of the second order), Hilbert (method of infinite number of independent variables), Klein (the "Mathematical Encyclopædia"), Lorentz (partition of energy between matter and ether), Mittag-Leffler (representation of functions of a complex variable). Newcomb (lunar theory), Picard (analysis and mathematical physics), Poincaré (subject to be announced). Veronese (non-archimedean geometry).

From March 25 to May 5 the Italian State railways will issue tickets at reduced fares to those attending the congress from the frontier stations, as well as for ten separate journeys in any part of Italy. In addition, all members are granted free admission to the principal museums and galleries in Rome between April 1 and April 12. The subscription is fixed at 25 lire (1*l.*) for members, or 15 lire for those belonging to the family of a member who desire to enjoy the same privileges; but to obtain railway vouchers for the outward journey subscriptions have to be received before March 25 by the treasurer, Prof. Vincenzo Reina, 5 Piazza S. Pietro in Vincoli, Rome.

From the point of view of the English mathematician, the time fixed for the congress this year is somewhat inconvenient, as those who attend will doubtless wish to see something of Rome at the same time, and not only are our Easter vacations, as a rule, very short, but in many cases they do not even cover the period fixed for the congress. These difficulties could have been obviated by holding the congress at its more usual time in the summer vacation, and had this been done no inconvenience would probably have been experienced from the heat, though some people might have been deterred from attending owing to fears in this respect. In view of the fact that only seven Englishmen attended the last congress, it is important that everyone who can attend should do so this time, even if this involves an extension of their holiday beyond the ordinary limits of the school or college vacation. It would be a great pity if anyone were debarred from attending these gatherings merely for the sake of a week's teaching to a class of elementary pupils, and it is to be hoped that the governing bodies of our schools and colleges will not allow such small obstacles to stand in the way of their mathematical representa-