

fine boggy silt which has been cut into small islands by the Mons stream. On July 12, 1930, the silt was so saturated with water that virtually no footing could be obtained. The only marking that could be accomplished consisted in erecting a small cairn on a prominent boulder projecting and in contact with the terminal ice. Fig. 3.

The retreat during the past four years has averaged 60 ft. per year, contrasted with the estimated retreat of 15 ft. per year, based on the descriptions of Hector and Walcott.

It is now possible to show diagrammatically the alterations which the retreat of the ice has made in the terminal streams, and the converse action of stream erosion which became prominent soon after Walcott's visit in 1919, when the Mons stream secured its new channel between Lake Moraine and the ice-front. Fig. 4.

Summary

The Lyell ice-front, during the period 1926-30, presented a more rapid rate of retreat than during any recorded period preceding. This is attributable, in part, to erosion by water.

J. MONROE THORINGTON.



TWO RELIEF MAPS OF THE CANADIAN ROCKIES

It is stated (*Encyclopedia Britannica*) that the first tridimensional maps were made by the Incas of Peru. The name "relief" was not applied until a much later time, but probably always has expressed the topographer's feelings when the work was completed.

More than twenty-five years ago the Canadian artist, Mr. F. M. Bell-Smith,¹ made sculptured reliefs of the mountains adjacent to the Canadian Pacific Railroad, which were familiar to travelers and climbers at the hotels of Lake Louise, Field and Glacier.

During 1928-30 I constructed two reliefs of portions of the Canadian Rocky Mountains for the American Alpine Club. The first of these covers the region adjacent to Athabaska pass, from Wood River to Fraser and Athabaska sources.² The second includes the mountainous area adjoining Howse pass and includes the upper drainages of the North Saskatchewan and Bush Rivers. These are the first reliefs to be made of the country along these two historic routes across the Continental Divide, the work having been made possible by the excellent maps of the Alberta-British Columbia Boundary Commission.

The making of reliefs is carried on by the Topographical Survey of Canada, one of the Banff section being especially interesting. Their method is to cut the 100 ft. contours from thin cardboard,

¹ "An Artist's Reminiscences," *C. A. J.*, ix, 90.

² A labelled photograph of this relief appeared in *C. A. J.*, xvii, 17.

and build up the resulting levels; thereby producing an extremely accurate result. This technique is, however, laborious and expensive, and as a somewhat reduced vertical scale is used (presumably to avoid cutting thick cardboard for the sections), the completed model had a flat effect not altogether pleasing to the mountaineer.

The method which I have adopted is simpler, less expensive, somewhat less accurate, but satisfactory to exhibit general topographical relations. The maps of the Boundary Commission are on a scale of one mile to the inch (1:62,500). Having decided to cut sections upon the contours of 500 ft. interval, I had poured for me a series of plates, each 3 mm. in thickness, sufficiently large to cover the lowest contour of the relief. The plates are composed of a mixture of beeswax and resin, with a melting point of 95° F.³ Calculating 25 mm. equal to one inch, it will be seen that when eight of these plates are superimposed it is equivalent to 4000 ft. of vertical height. This means about 1.25 inches to the vertical mile, an exaggeration of elevation which produces peaks of elegant line. No one will begrudge this concession to the vanity of the climber.

To begin the work, a basal wax-plate is placed on a board and the map laid on top of it. Long pins are pushed through the summit locations of every principal peak and are forced through the wax into the board. The pin-heads are then cut off with a wire-cutter, leaving the shanks projecting. These pins serve as registration points in orienting the plates which follow. The map is then carefully lifted off.

Next the map is placed on another wax-plate and the locations of the principal peaks pricked through with a pin. Then, with a dull pencil, the lowest contour is followed throughout its entirety. When the map is lifted off, the impression of the contour is visible on the plate and is easily cut out with a small scalpel, warmed in a flame. A similar procedure is gone through with each succeeding 500 ft. contour, the cut plates being superimposed on the preceding ones and aligned on the localization pins.

When nearing the 7,000 ft. contour the massif usually begins to break up into "islands," demanding greater care in the registration and orientation. The mountains now appear as a series of rising step-formations, with the general topography and angle of slope plainly evident. After all of the contours have been cut and mounted, plastolene is smoothed into the steps and all excess rubbed away with the finger-tips. When this is properly done the upper contour-edges of the wax-plates should barely project through, leaving the

³ Such plates can usually be obtained through the larger biological institutions, where they are used in the reconstruction of embryos from microscopic serial-sections. The plates can be poured in any thickness desired. The cost of all material for the Freshfield-Lyell relief (wax-plates, casting and case) was less than fifty dollars. The time required in making the relief (exclusive of casting)—which includes the northern half of Boundary Sheet 17, all of Sheets 18 and 19, and the southern half of Sheet 20—was approximately sixty hours.

contouring just visible. Next, the plastolene is modeled upward over the summit-block of each peak, carefully following the angle of slope. The localizing pins are then cut off flush with each summit, and there is usually no difficulty in recognizing a given peak by its shape when compared with photographs from different sides.

The completed model is now cast in plaster; any professional will do this for a small sum. I have the plaster made in a terracotta tone, and a layer of chicken-wire and burlap sunk into the base to strengthen it.

The cast is then ready for painting. The snowfields and glaciers are drawn in with Chinese white, their extent being taken from the map and applied to the contours of the model. The rivers are drawn in with a hard blue pencil, and the timber stippled with green opaque water-color to its proper height. Photographs are here of considerable service. The peaks are given appropriate tones and the Continental watershed drawn on with ink. The model is sprayed with several coats of varnish, and legend numbers are attached in suitable locations. An orientation mark of the cardinal points of the compass should be made on the model itself. An explanatory legend is mounted with the relief in its case, the cast being attached to the base-board by brass hooks. A small-scale map, with inked outlines showing the extent of the relief in relation to the surrounding area, may be added. An improved effect is produced by painting the inner lateral walls of the case a sky-blue.

The making of such a relief is a great lesson in topography and impresses one with details not easily learned in any other manner. For the observer, a model visualizes the relations of complicated mountain groups much more easily than a flat map. One can trace old routes and work out new ones. Indeed, if one makes use of such a relief in preparing for an expedition, it may save great loss of time in the field by ruling out at once certain lines of approach that otherwise might be discarded only after bitter experience of trial and error.

J. MONROE THORINGTON.



A MOUNTAINEER'S ROUTE TO THE SUMMIT OF MT. WHITNEY

The completion of the new trail to the top of Mt. Whitney, which enables almost anyone who can ride a horse to reach it, together with the fact that this mountain is the highest in the United States proper, intrigue the mountaineer with a desire to find a real climbing route to the summit. It appears that it can be ascended by the northwestern shoulder, no difficulty being apparent except possibly a stretch of rather steeply-shelving rock best negotiated with rubber-soled shoes. The north face, consisting of very wide, shallow couloirs separated by low ribs can be readily scaled. Early