His change from Vienna to Munich in 1935 was very advantageous for his research work, for he succeeded the well-known polar scientist, Professor Erich von Drygalski. Together with the latter he rewrote his small book of 1902, *Gletscherkunde*, changing it into the big volume of the same name in the Encyclopedia of Geography, published in 1942 by F. Deuticke in Vienna. In this work the physics of glacial research and of ice is covered, in addition to the temperatures, structure and distribution of the glaciers in many parts of the world. A work was thus brought into being which, in spite of the rapid progress of glaciological knowledge, has not lost its basic value.

Machatschek was a master in the field of geomorphology, which in so many respects is very close to glaciology; among his many important writings his standard work, *Geomorphologie*, stands supreme and is now in its sixth edition.

R. FINSTERWALDER

REVIEWS*

1958 GLACIAL MAP OF CANADA, 1 : 3,801,600, 1·6 × 1·3 m. Published by the Geological Association of Canada with support from the Geological Survey of Canada, Defence Research Board and the National Research Council.†

CANADA, still rimmed on the north-east and west by glaciers, was the seat of the largest of the Pleistocene ice sheets, comparable in size with that of the Antarctic to-day. It is therefore the largest scale laboratory for the erosional and depositional effects of a lately removed ice load. But when at the end of the last war Professor R. F. Flint published his comprehensive *Glacial Map of North America* [1] the detail in the Canadian area was slight and in no respect treated like the area of his own special investigations in the northern United States. This was not surprising. Northern Canadian topographic maps then were sketchy to a degree, and in only a few scattered localities had useful work on glacial features been done by geologists.

In the succeeding years, however, a tremendous programme of aerial survey has been carried out by the Royal Canadian Air Force and the whole country is now mapped on the scale of 8 miles to the inch, with at least oblique photographs of every square mile of territory. Using these photographs, Professor J. Tuzo Wilson and his team of interpreters have produced this new map, advance information on which was given to the Commission on Snow and Ice (I.U.G.G.) at the Congress at Toronto in September 1957. Much of the detailed work of compilation and draughting was done by this society's member George Falconer.

It is a lavish production with at least eight colour plates used. Only a North American printer could have handled a map of this size—almost too unwieldy for the user. But we can enjoy the appearance on this scale for the first time of a clear representation of existing glaciers and ice caps. The Melville Island glaciers, as yet I believe, unseen except from the air are here, but the Labrador cirque glaciers do not show—even on this scale they could perhaps have been indicated. Ice movement features, drumlins, crag and tail and striae, cover a great deal of the map, appearing noticeably less densely in the forested areas where even the flying camera cannot pick them out. It is from these as from the eskers that the general pattern of latest ice flow is to be assumed. The compilers have, perhaps rashly, added *ice divides*, one of which (in Keewatin) they admit in a footnote to be in controversy among themselves. I would suggest that it is equally dangerous to mark in any Keewatin ice divide, preferring to believe with Bird [2] that all later ice movements here came from a Hudson Bay centre. It is difficult to see how drumlins and eskers can appear at the same time stage

* Shorter reviews and lists of works received will be found in *Ice*, the Society's News Bulletin.

† This map is distributed by the Geological Association of Canada and may be obtained from the Secretary, Room 703, 111 St. Clair Avenue West, Toronto 7, Ontario, Canada, at $2.00 (Students $1.00).

on either side of a "divide" running in allegedly opposite directions and separated by only a few tens of miles of country. Whence came the material?

Some marine depths would have enhanced the map to show the submarine river courses and basins in Hudson Bay and the morainal banks off Baffin Island. But in much of the map area such information is still woefully scarce and is badly needed to advance the general glacial picture.

Major outwash areas and moraines, great and small, are also depicted as are the unglaciated regions of Canada. These include a "certain" one in the Blairmore foothills area, and two "probables" in the Nahanni and Keele river areas west of the Mackenzie where the Cordilleran and Laurentide ice sheets may have failed to coalesce. Also shown is the unglaciated north-west Yukon and portions of Banks Island and the Queen Elizabeth group. This is the first time anyone has been bold enough to indicate the latter unglaciated territory on a map. But from the aerial photos it has for some time been evident that this lake-free area with frequent smooth radial drainage is strikingly different from most of Canada. Included here is the vexed problem of marine submergence. The Queen Elizabeth group is shown with a comparatively narrow fringe of colour wash indicating maximum extent of drowning. This would be in agreement with findings elsewhere. If these islands lay on the whole beyond the ice sheet margin one would expect a crustal uplift to compensate for the down-warping under the ice load nearby. So the submergence may have been slight.

But another set of features is shown (in black) with a prominence out of proportion to their reliability. These are "marine shells, strandlines, and sediments" marked with heights above existing sea level. Included are all the earliest reports, often unverified (if in fact they are verifiable) up to the 900 ft. "marine sediment" at Cape Wolstenholme. The proof of marine origin of features is a very tricky business. For instance, in Pangnirtung Fiord a marine strandline is marked at 450 feet. This can only be from Weeks' report.[3] Thompson [4] has pointed out that Weeks used the lower limit of perched blocks as his submergence criterion, alleging that such boulders would be displaced by wave action. But Thompson found perched blocks right down to sea level and no sound evidence of marine features at any elevation in the fiord. It may well be that most of the map stations could similarly be discounted and this reviewer would prefer to have seen instead the approximate heights above sea level given to the general margin of the submerged land areas.

The compilers appear in a negative manner to have come down against the nunatak-refuge theories for Gaspé and Ungava-Labrador. This is inferred by the entire absence in the east of the contour symbol "upper known limits of ice action" which appears prominently in the Western Cordilleran region. A reviewer more experienced in this area might cavil at some of these contours. But for the east Wilson and his team are in agreement with many recent workers such as Ives.[5]

The general draughtsmanship on the map is excellent and the colour register surprisingly good considering the great size. The background detail is in a pleasant unobtrusive but legible grey. A small criticism is that some rather meaningless notes were inserted (in small red figures) apparently as an afterthought since they are at times obscured—as at the Ellesmere Shelf Ice—by other printing.

Altogether the map is a large and stimulating forward step in the portrayal of Canada's glacial story, and those who worked on it and produced it are to be congratulated.

P. D. BAIRD

REFERENCES

1. Flint, R. F. Glacial Map of North America. *Geological Society of America*, Special Paper No. 60, 1945.
2. Bird, J. B. The physiography of the middle and lower Thelon Basin. *Canada. Department of Mines and Technical Surveys. Geographical Branch. Geographical Bulletin*, No. 1, 1951, p. 14-29.
3. Weeks, L. J. Cumberland Sound Area, Baffin Island. *Canada, Department of Mines, Geological Survey Summary Report* 1927, Part C, p. 91. (Ottawa 1928.)
4. Thompson, H. R. McGill University Ph.D. Thesis, 1954.
5. Ives, J. D. Glaciation of the Torngat mountains, northern Labrador. *Arctic*, Vol. 10, No. 2, 1957, p. 66-87.