GLACIAL HISTORY OF COVEY HILL[1]

PAUL MACCLINTOCK[2] AND J. TERASMAE[3]

ABSTRACT

The abandoned spillway across Covey Hill has long been accepted as one of the overflow channels of the Great Lakes, occupied when "the ice sheet" had receded to a position north of the Adirondacks but still blocked the St. Lawrence drainage below this level, now a thousand feet above present sea level.

Current investigation reveals that the area has been glaciated by two Wisconsin ice invasions. The first one came from the northeast and overrode the whole area, whereas the second one came as a readvance from the northwest and only impinged against the north flank of Covey Hill where it built a terminal moraine. It was this latter ice that dammed the St. Lawrence and caused its drainage to overflow at Covey Hill. Radiocarbon dates on peat and on Champlain Sea shells, which overlie this latter till, show it to be pre-Two Creeks, i.e., Port Huron in age. Covey Hill gap is therefore also dated as Port Huron (Mankato) in age. Along the north slope of Covey Hill is a well-developed marine shore line at 525 feet above present sea level, whereas in the lowlands to the north the base of the marine Champlain clays is now at 200 feet above present sea level. These clays lie here on varved lake clays, the top of which show mud cracks, dessication breccia, oxidation, and fluvial erosion, and they demonstrate an episode of dry land which was later flooded by eustatic rise of sea level to make the Champlain Sea. These relations demonstrate that sea level had been lowered at least 325 feet during this part of the Pleistocene.

INTRODUCTION

Covey Hill has long been a spectacular landmark in the glacial history of North America. It is the bold northern terminus of the Adirondack upland where this latter projects northward, as a "bastion," from New York State across the border three miles into Quebec Province. The hill rises 900 feet from the St. Lawrence lowland, on the north, to an altitude of 1,100 feet. Its summit is separated from the upland in New York by a gentle flat-bottomed col a half-mile wide and a mile long of altitude 1,010 feet, known as Covey Hill Gap. This col has been washed clean of the glacial drift which litters surrounding terrain. Its flat bottom is now covered with a layer of peat six feet thick lying on the bed rock. It was hoped that a sample of this peat might give a radiocarbon age that would date the glacial events.

A small box-canyon has been cut down the eastward descent of the col, from 1,000 feet altitude descending to about 750 feet. This little canyon in places is 75 to 100 feet deep, with vertical sides, cut in horizontal Potsdam sandstone. It contains two deep little lakes. The upper, western lake, which is locally known as "the Lake," lies at the foot of what was evidently a vertical or overhanging rim before large slabs collapsed. Soundings show a depth of 75 feet of water above a muddy bottom, at the western end, shoaling to about 35 feet in the mid-portion and to 5 feet at the eastern end. A wet-weather trickle of water enters at the west end and leaves at the east end among the blocks of rock that litter the valley bottom. Half a mile farther down the little canyon, and crossed by the international boundary, lies a second stagnant pool locally known as "the Gulf"and locally described as 70 feet deep (fig. 3, longitudinal profile of Covey Hill Gap). Good descriptions have been published by Woodworth (1905), by Fairchild (1912), and by W. Goldthwait (1913), all of whom consider the phenomena to have been made by the erosion of a major torrent and waterfall when "the ice sheet," during its recession from the Adirondacks, still dammed the St. Lawrence and diverted the outlet waters of "Lake Iroquois" across this Covey Hill Gap. It has long been a question in the minds of many people just how a recessional stand would remain at the right place long enough to produce the phenomena as seen.

DAMMING BY READVANCE

Current investigations of the Pleistocene history of the St. Lawrence lowland by the New York State Museum (MacClintock, 1954, 1958) has shown that there were two ice invasions in the region. The earlier

[1] Manuscript received June 12, 1959.

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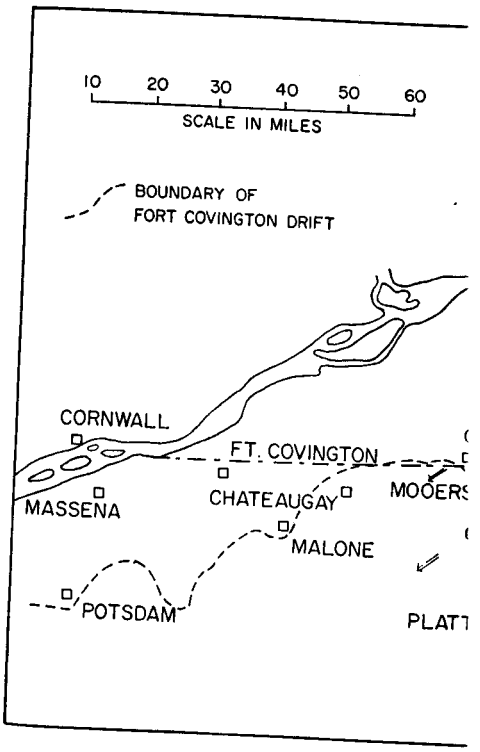

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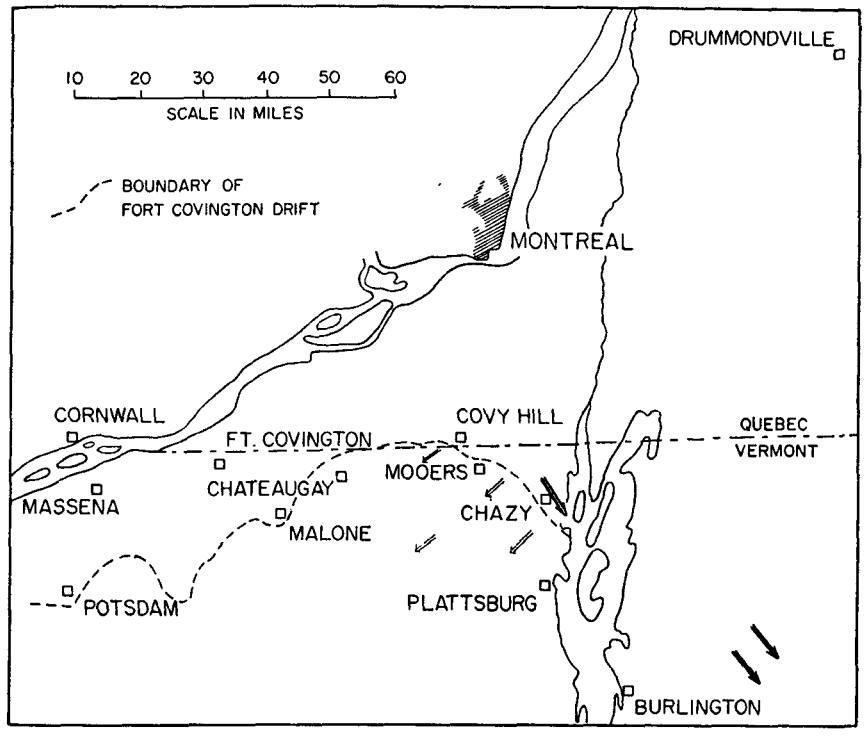

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dack upland with lobes pushing into the
re-entrants excavated by Oswegachie, Gran-
nis, Raquette, St. Regis, and Salmon rivers,
to deposit a fairly good terminal moraine.
This moraine exhibits knob-and-kettle to-
pography above the altitude of 525 feet;
but where it lies below this altitude, it
has been softened and flattened by waves
of the Champlain Sea. The drift, however,
is still recognizable as Fort Covington by
the northwest orientation of its till fabric.

This Fort Covington moraine crosses the
Covey Hill area from the city of Malone
on the Salmon River at the west to Lake
Champlain at the east (fig. 1). In this dis-
tance it is traced northeastward from Ma-
lone across the northwest corner of the
Chateaugay quadrangle where it locally de-
termines the course of Alder Brook (fig.
2), of Allen Brook, and of Hinchinbrook
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north of Earlville. It is thence traced northeastward up the northwest flank of Covey Hill, where it determines the courses of Mitchel Brook and the east branch of Outarde River, causing them to flow "slantwise" down the northwest slope of the hill. Topography and till fabrics show the moraine to mount the north slope of the hill to within about 100 feet of the summit. The summit, however, has the striae, north 70° E. and north 50° E. of the Malone glaciation. On the east slope of the hill, at altitude 850 feet, northwest till fabrics show that the Fort Covington boundary passes southward into the United States a mile

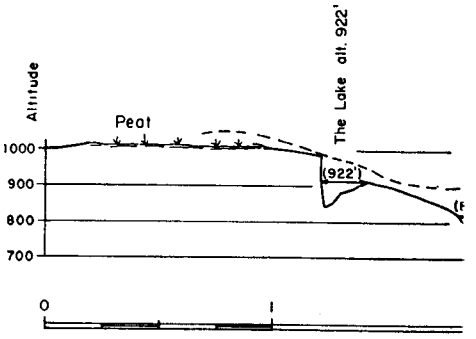


FIG. 3.—Profile of east

south of Covey Hill village. This boundary is thence traced eastward passing a mile north of Mooers and a mile south of the village of Champlain to Lake Champlain, southeast of Chazy. North of this moraine boundary, as thus traced, striae and till fabrics are from the northwest (fig. 4), whereas south of this boundary they are from the northeast, i.e., Malone (fig. 5). Evidently, therefore, the Fort Covington ice pushed southward across the lowland, damming the St. Lawrence drainage, and impinged against Covey Hill, thus impounding a lake and causing it to overflow at the Covey Hill Gap into the Lake Champlain depression. It may well be, also, that waters of an older ice-marginal lake during the waning of the Malone ice flowed through the Covey Gap, for there are four such cols

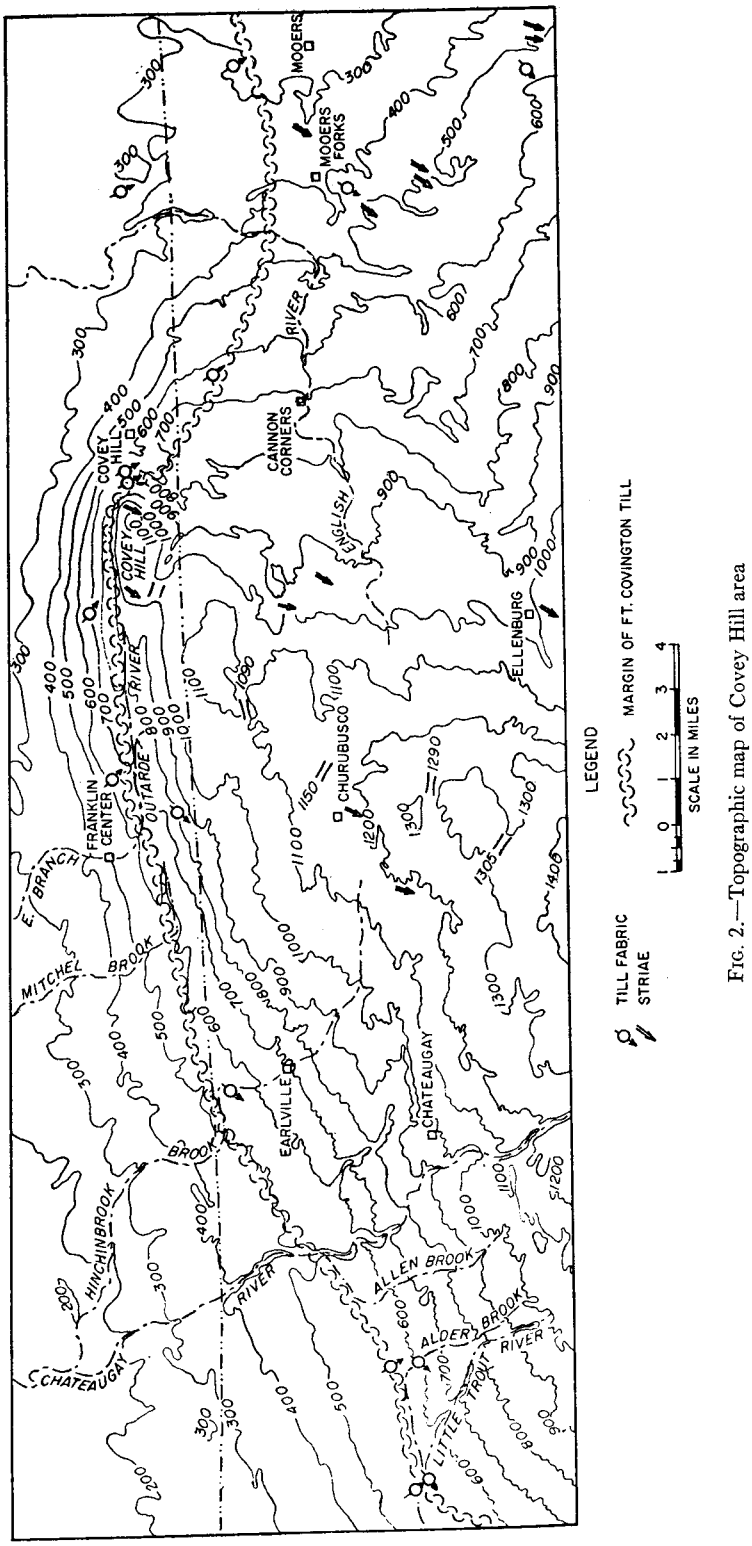
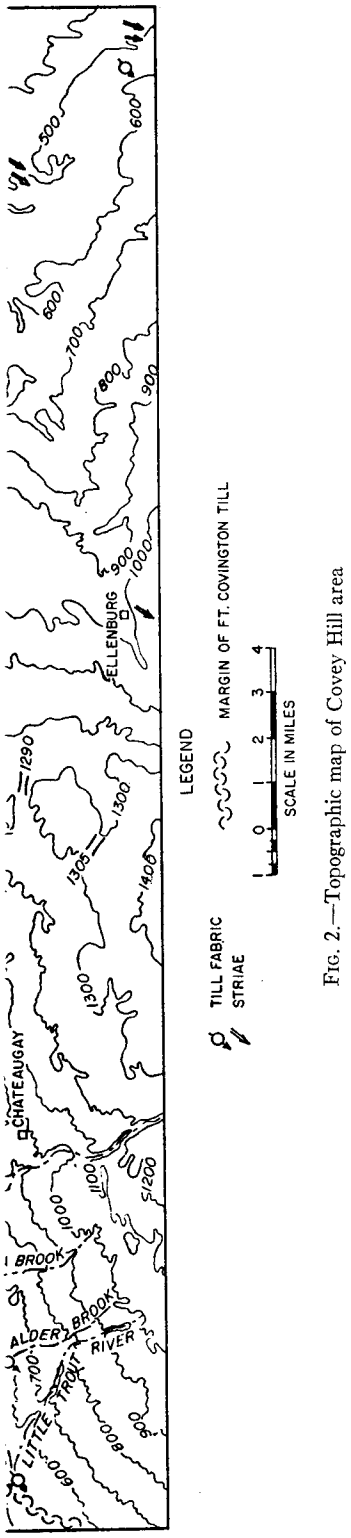


FIG. 2.—Topographic map of Covey Hill area



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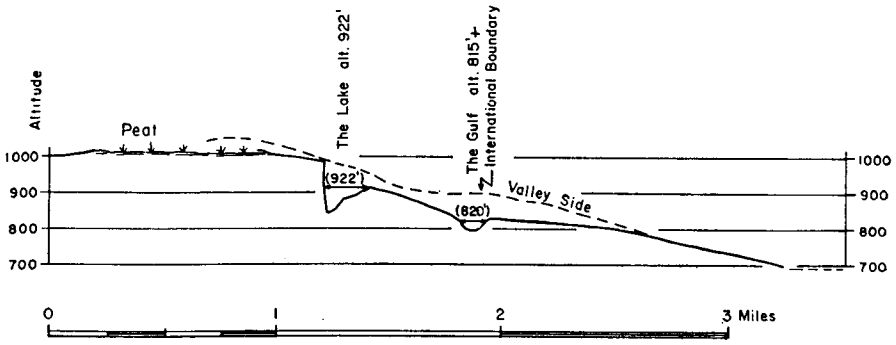

FIG. 3.—Profile of east slope of Covey Gap

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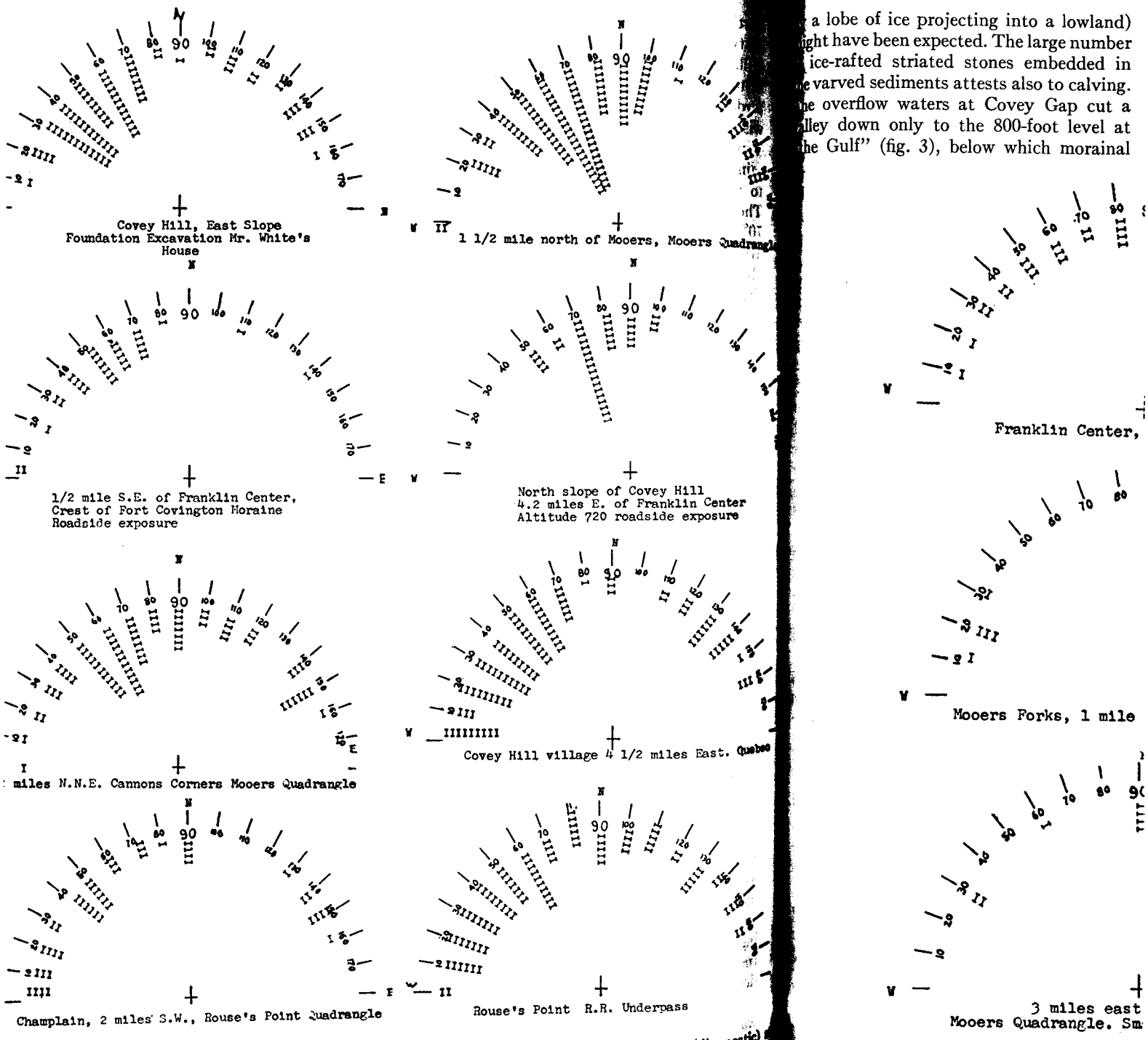
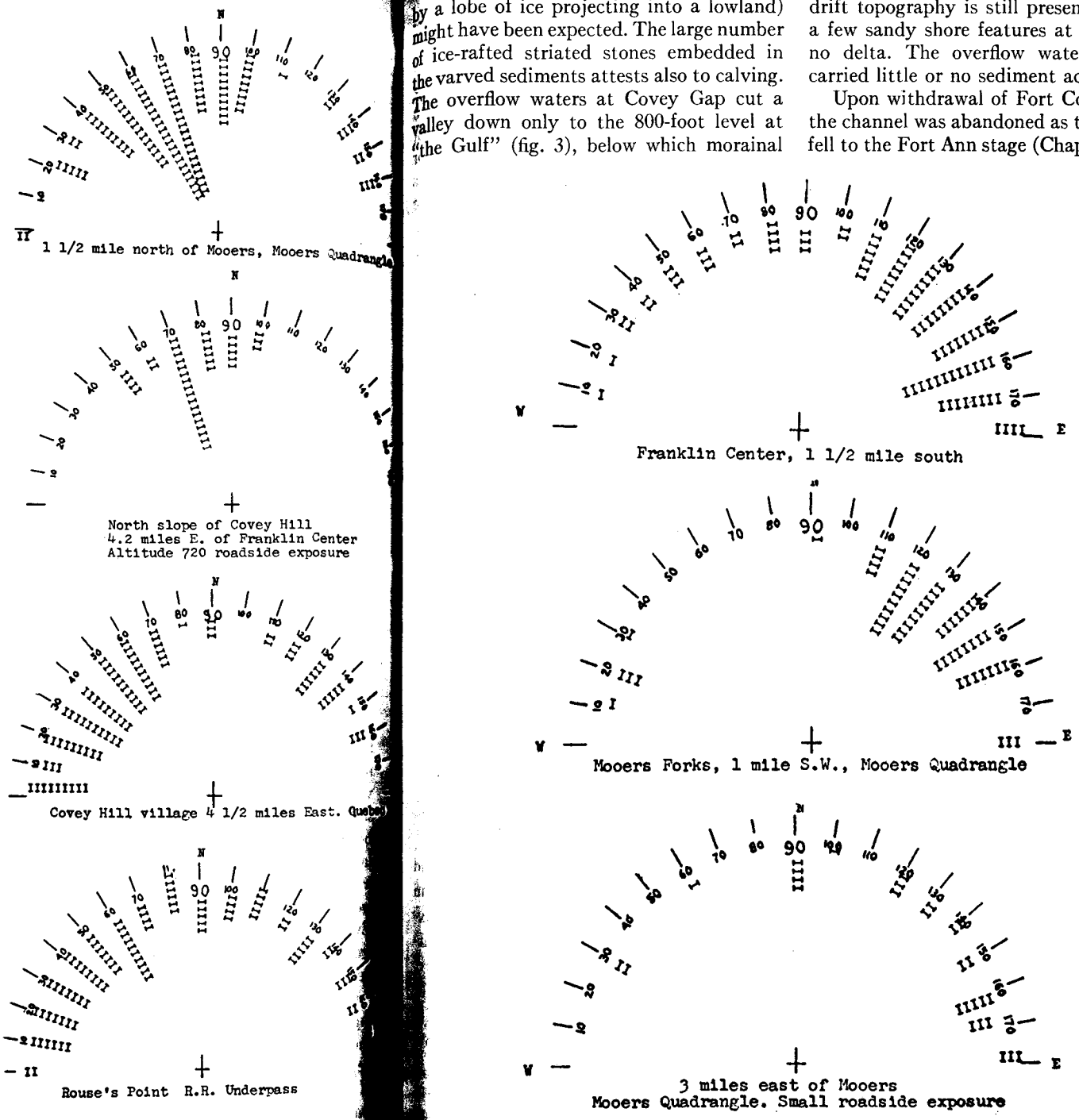


. 4.—Diagrams of Fort Covington till fabrics showing the strike of the long axes of the flat-lying (diagnostic)

FIG. 5.—Diagrams of Malone till fabrics

by a lobe of ice projecting into a lowland) might have been expected. The large number of ice-rafted striated stones embedded in the varved sediments attests also to calving. The overflow waters at Covey Gap cut a valley down only to the 800-foot level at "the Gulf" (fig. 3), below which morainal drift topography is still present. There are a few sandy shore features at 800 feet but no delta. The overflow waters evidently carried little or no sediment across the col.

Upon withdrawal of Fort Covington ice, the channel was abandoned as the lake level fell to the Fort Ann stage (Chapman, 1937),



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where a large body of water was confluent in the Champlain and St. Lawrence lowlands with shore lines at present level of 725 feet in Covey Hill area. The large delta of the Salmon River at Malone was built into this lake, as well as that of Saranac River at Morrisonville. Also varved lake clays were deposited on the Fort Covington till—now found as far north as Ottawa and northeast as Drummondville. The best exposures, as might be expected, were seen in the great excavations for the St. Lawrence Seaway and Power Projects, and a great many test drill cores contain the varved clays between till below and marine clays above. The marine clays are not varved and very commonly contain fossil shells. In both the cores and the exposures the upper foot or two of the varved clays are fractured into a sort of "breccia" and then welded together again into a solid mass of clay. The varved clay and the top foot or two of the underlying till is oxidized to buff color, whereas the overlying marine clay is still the slate-gray color of unoxidized clay. Furthermore, in exposure, marine clay in places lies directly on Fort Covington till, showing that varved clay either had not been deposited or had been eroded prior to marine deposition. Therefore there was an episode of emergence during which the varved clays were dried out, cracked and broken, and chips washed together to form the "breccia." The varved clays were also oxidized and were fluvially eroded prior to burial by marine clays. This meant, therefore, that when the ice dam broke that had held Lake Fort Ann and the lake was drained, its bottom was dry land above the glacial low sea level of the time. This relationship is shown in figure 6, which portrays isostatic rise of land and eustatic rise of sea in postglacial time.

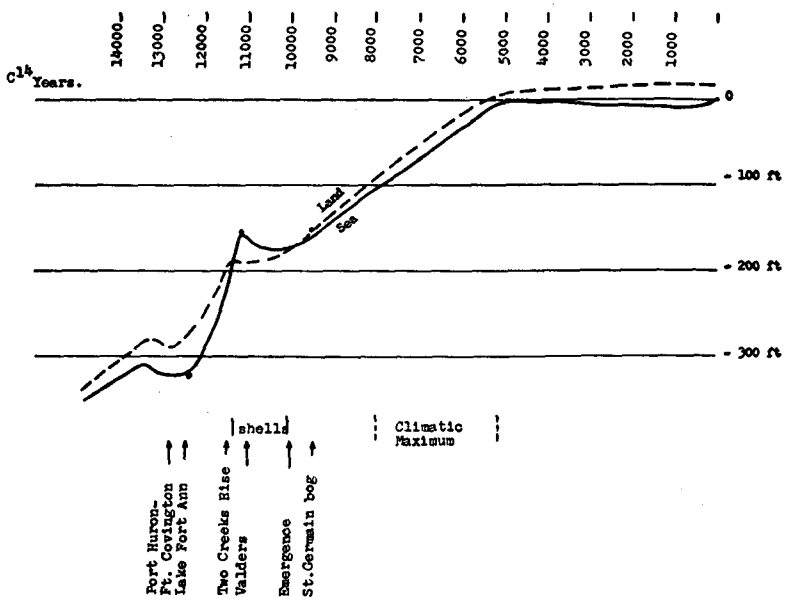

FIG. 6.—Isostatic rise of land and eustatic rise of sea during late glacial and postglacial time. Based largely on: (1) general rise of sea level after Godwin, Suggate, Willis (1958); (2) Champlain Sea shells (10,300 to 11,300 C^{14} yrs.) Y-215, Y-216, Y-233, Gro-1696, Gro-1697; (3) Port Huron (12,800), Y-240; (4) St. Germain bog (9,500), Lamont 441C; (5) top of Lake Fort Ann varves 325 ft. below marine shore line, Covey Hill.

CORRELATION AND AGE OF THE FORT COVINGTON GLACIATION

No material which could be dated by radiocarbon has yet been found in the drift. However, the Champlain Sea sediments above the Fort Covington till, do contain shells which have been variously dated from 10,300 to 11,300 years (Y-233, Y-215, Y-216, Y-217, Gro-1697, Gro-1696 [Preston, Person, and Deevey, 1955; de Vries, 1958]). Doubt has been expressed as to the reliability of these dates, since the organisms were living in estuarine environment of "dead" carbon. But recent work (Broecker and Orr, 1958; de Vries, 1958) shows that the carbon in the surface waters was so nearly in equilibrium with that in the atmosphere that "dead" carbon affected the age determination less than 3 per cent for shallow-water forms, like *Mya*, *Macoma*, and *Hiatella* with which we are dealing. It has also been suggested that postdepositional replacement of the carbonate in the shells has brought in "dead" carbon to make the dates appear older than they really are. The shells, however, show little, if any, evidence of replacement of carbonate. Some are somewhat chalky, but the majority are still dense. Numbers of them retain some mother-of-pearl and greenish-brown or bluish color of the original shell and, in many cases, the original chitin.

X-RAY DIFFRACTION

To test the validity of the replacement idea, samples of *Macoma* and *Hiatella* (*Saxicava*) shells from Champlain Sea deposits were subjected to X-ray diffraction analysis. The *Macoma* shell material showed aragonite peaks at 27.2°, 31.0°, 33.2°, 36.2°, 37.8°, and 38.4° and no calcite peaks. The Hiatella material showed aragonite peaks at 33.2°, 36.2°, 38.0°, and 38.6°; also no calcite peaks. Since modern *Macoma* and *Hiatella* likewise give only aragonite peaks with no calcite and since any postdepositional replacement would have been with calcite, this evidence shows that there has been no replacement. If, therefore, the radiocarbon dates are trustworthy, as they now seem to be, the Cham-

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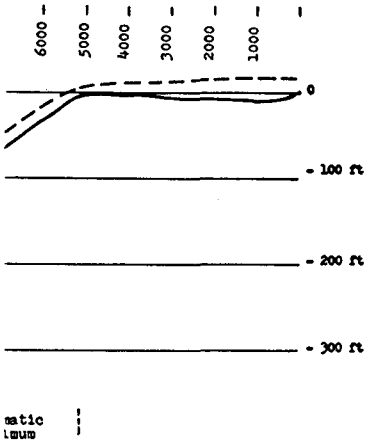

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DESCRIPTION OF THE POLLEN PROFILE

A reconnaissance of the bog, made by test borings with the Hiller peat sampler, showed that generally the peat cover over bedrock is thin, about 3–5 feet. The peat lies either directly on rock or is underlain by a thin layer of sand. The pollen profile was sampled through the thickest peat section, and the underlying lacustrine deposits were encountered during this reconnaissance. At the sampling site the thickness of the organic deposits was 190 cm. (6′3″).

A palynological study of the peat has been compiled in a pollen diagram (fig. 7). Correlation of this pollen profile with the others of postglacial deposits in the St. Lawrence lowlands (Terasmae, 1959*b*) shows that the pollen record obtained from the Covey Hill bog extends back to pollen zone IV. The pollen profiles in the lowlands near Drummondville extend back to pollen zone VI, which is dated at about 9,500 years by Lamont 441C. Pollen zone IV probably dates about 7,500 years B.P. Therefore, it appears certain that the pollen record from the Covey Hill channel does not reach back to the time when this channel was abandoned because of ice retreat from the Covey Hill. Two probable reasons can be suggested: (1) owing to the large size of this bog, its oldest sediments were not found during this reconnaissance, and (2) because the channel was cut into the Potsdam sandstone and all drift removed by the fast-flowing river, a rather sterile, shallow lake remained after the channel was abandoned, and conditions for a long time were unfavor-

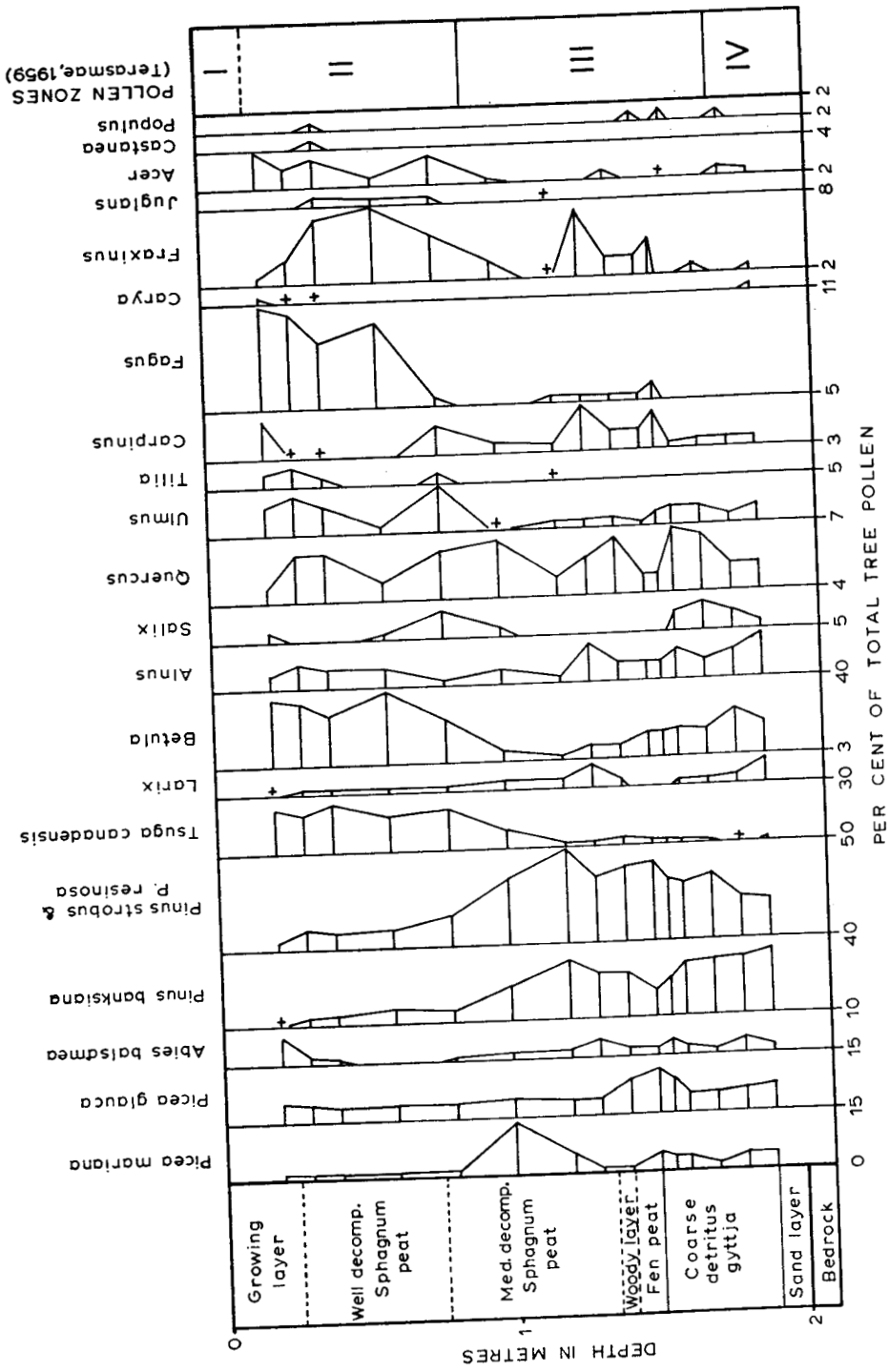

Fig. 7.—Pollen diagram of Covey Gap bog

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Results of the palynological studies made in the St. Lawrence lowlands as well as radiocarbon dates clearly indicate that the ice retreat from the Covey Hill must have occurred before the Champlain Sea episode; hence the old channel must have been abandoned early in Two Creeks time, because the Champlain Sea episode was at least

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ble for accumulation of lacustrine organic deposits.

Results of the palynological studies made in the St. Lawrence lowlands as well as radiocarbon dates clearly indicate that the ice retreat from the Covey Hill must have occurred before the Champlain Sea episode; hence the old channel must have been abandoned early in Two Creeks time, because the Champlain Sea episode was at least in part contemporaneous with that interval (Terasmae, 1959*a*).

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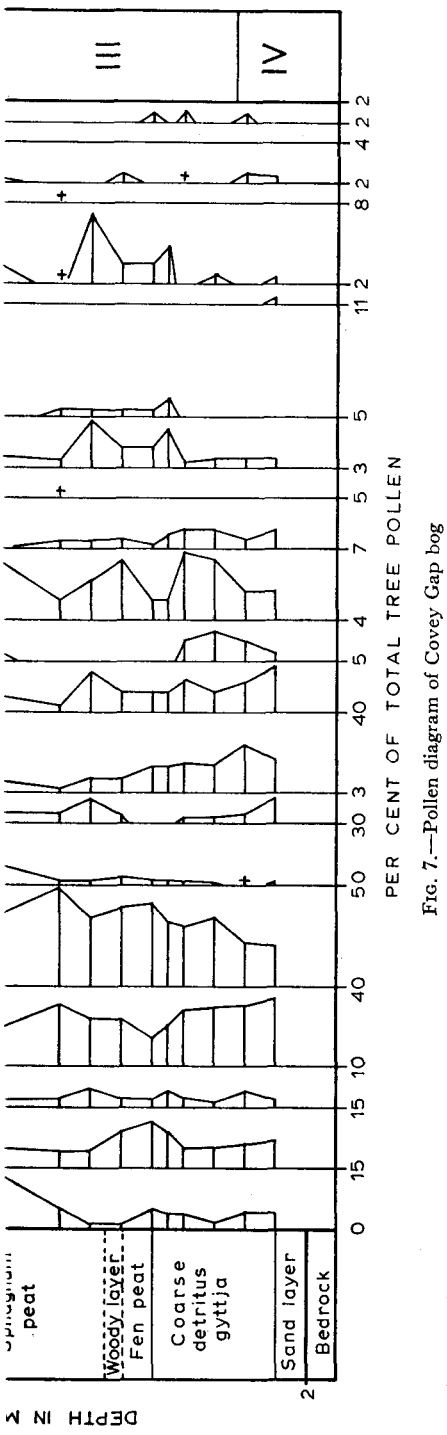

FIG. 7.—Pollen diagram of Covey Gap bog

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