A STUDY OF LAKES
IN
NORTHEASTERN VERMONT

By

JOHN ROSS MILLS

VERMONT GEOLOGICAL SURVEY

CHARLES G. DOLL, *State Geologist*

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INTRODUCTION

Purpose of Study

A program of mapping the subaqueous topography and depths of fourteen lakes in northeastern Vermont was undertaken by the writer during the months of June, July, August, and September, 1948, under the direction of the Vermont Geological Survey.

The primary purpose of this investigation was the accurate mapping of the bottoms of these lakes and the study of the types and locations of bottom sediments. Data describing the characteristics of the shore lines was also collected. The influence of prevailing winds and winds of storm velocity, with their resultant lake currents, together with stream deposits and location of sand beaches, are discussed. Sand samples were collected for purposes of size and sorting correlation of lake sediments and the results tabulated in Appendix A.

ACKNOWLEDGMENTS

Material for this study was collected while the writer was employed by the Vermont Geological Survey under the supervision of the State Geologist, Dr. Charles G. Doll, whose suggestions and helpful guidance are hereby acknowledged. Dr. Bradford Willard of Lehigh University has been most generous with his time and helpful suggestions in the preparation of the maps and manuscript. The writer also wishes to thank Mr. Christopher D. Mills for his valuable assistance in the field and office.

Method of Investigation

A detailed account of the method used in mapping the topography of the lake bottoms is contained in Appendix B.

The general descriptions of the individual lakes constitute the major part of this report. The writer suggests that the maps of the lakes be used in connection with this part. The detailed description of each lake follows the outline below:

I. Location, size, and surrounding terrain features of the lake.
II. Water affluent and effluent.
III. Shore conditions, bottom conditions, and their probable causes, including features of stream deposition; prevailing and storm winds, and their effect on wave action, current flow, shore line erosion and deposition of lake sediments.

The summary consists of a discussion of the various factors that have influenced sedimentation in the individual lakes and attempts to evaluate their cumulative influences.

Appendix A consists of the tabulated results of sizing and sorting analysis of sand samples.

A folder containing maps of the lakes is attached to the back cover. Specific locations referred to in the text, are numbered on these maps.

Location

The locations of the lakes described and mapped in this report are situated in Essex and Orleans counties in the extreme northeastern part of Vermont. The topography of the area is shown on the Averill, Island Pond, Memphremagog, Lyndonville, and Guildhall 15-minute Topographic maps of the United States Geological Survey. An index map (Plate 1) showing the location of the lakes is in the pocket.

GENERAL GEOLOGY

The lakes described herein occur in highly folded, faulted and metamorphosed rocks, generally considered as Ordovician in age. There were at least three periods of orogeny in this area. The first occurred at the end of the Cambrian period and was relatively mild, and the second, the Taconic orogeny at the end of the Ordovician period, which was intense with much folding and thrust faulting, especially west of the present Green Mountains. The third great period was the Acadian orogeny at the end of Devonian time, which affected particularily the area east of the Green Mountains, but with more igneous activity and metamorphism and possibly less thrust faulting.

According to Atwood[1] there were at least three major cycles of erosion before the advent of glaciation and the author believes that most of the mountains represent eroded remnants of the northward extension of the Schooley peneplain, with other, lower mountains or ridges representing the Harrisburg base-level. However, the lack of deeply entrenched major stream courses and elevated beaches in this region make positive identification difficult. The present day drainage pattern and topographic features were probably not developed during the pre-Pleistocene erosion, though a few individual features now visible seem to date to that time.

During Pleistocene time, continental glaciation gradually covered the whole of New England, modifying most of the surface features. The most striking action of the glaciation was the rounding of the stoss or north sides of mountains and the plucking of the southern or lee slopes, often greatly steepening them into sheer cliffs. Valleys were deepened and widened, with lateral scarps so cleared of loose material that many of them now appear as nearly vertical walls parallel to the direction of ice movement. It is possible that small valley glaciers formed either before or after the arrival or retreat of the continental glacier, or even at both times. The chief evidence of the small alpine glaciers is to be found in the small cirque-like depressions excavated at the heads of valleys that contained such ice tongues.

Much of the surface of this area is covered by ground moraine from 40 to 50 feet in thickness. Drainage in morainic areas is aimless or follows the glacial valleys, draining most frequently to the north and into the St. Lawrence River basin. This cycle of drainage is youthful.

Descriptions of Lakes

Big Averill Lake (Lat. 44°58′ Long. 71°42′)

Big Averill Lake (Plate 2) is a relatively large, rectangular lake about 3 miles long by 1¼ miles wide. To the north a mountain with a high steep rocky cliff on its southern side rises to an elevation of 1400 feet.

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[1] Atwood, Wallace W., The Physiographic Provinces of North America, pp. 67–95, 1940.

A gentle slope from the base of this cliff extends to the edge of the lake. On the west side of the lake a ridge rises gradually from the north towards the south and descends with uniform slope to the lake. A similar but lower ridge runs parallel to the eastern shore, descending steeply to the lake at the halfway point.

Three streams supply most of the water to Big Averill Lake, the largest being the outlet stream from Little Averill Lake, which flows through a swampy delta into the extreme southwestern corner of the former. Another smaller stream flows in at the southern end, dividing the crescent-shaped sand beach in the southeastern bay. At the northeastern corner a stream enters the lake through a flood-plain and marsh. A concrete dam in the northwestern corner of the lake controls the outlet flow. This dam is still effective in maintaining the water level but is no longer used to vary the storage capacity.

There is a vertical gap of about three feet between the first vegetation and the present lake level, which may be due to a former level of water maintained by the dam mentioned above. This barren area consists in general of granite bedrock or boulders, and an occasional sand beach. The gap is about two feet between soil and water on the western side and three feet on the eastern side, the difference being due to greater lake-ice action against the eastern side.

From Station E_2 to Station E_{12} the shore line is coarse-grained granite bedrock. Solution and wedging of joint systems in the granite bedrock have formed flat-iron shaped boulders, which are still generally in situ. These angular granitic blocks constitute the prevailing type of boulder found along the shores. The western shore has no exposures of bedrock and consists entirely of boulders of the same composition as the bedrock and generally angular in shape. At the water's edge and above, the upper surfaces of the boulders and the edges of the joints in the bedrock are weathered and rounded and appear to have been subjected to grinding by lake-ice and exposure to frost action.

A belt of fine sand encircles the lake completely, occurring in water 6 inches or less in depth, and extends outward to the twenty-foot depth contour line. The sand overlies the bedrock and surrounds the boulders along the shore line; the deeper the water the siltier and finer the material. In some areas (Station E_4 in particular) the sand between boulders is not compact and acts like quicksand. The shallow bottom appears to be almost entirely free of intermediate-sized material, which is very fine sand, large cobbles, or small boulders.

The two beaches on the lake seem to depend for their material upon the streams that flow across them. The southeastern beach is composed of very fine, well-sorted sand, while the northern beach is composed of slightly coarser sand. The streams have probably been largely responsible for the extensive sand deposits that extend offshore.

The prevailing winds are from the south and the northwest. There is a considerable amount of wood chip and sunken driftwood along all shores, especially near the two beaches.

Little Averill Lake (Lat. 44°57′ Long. 71°43′)

Little Averill Lake (Plate 3) lies nearly 1000 yards to the southwest of Big Averill Lake. The ridge that forms the west side of Big Averill

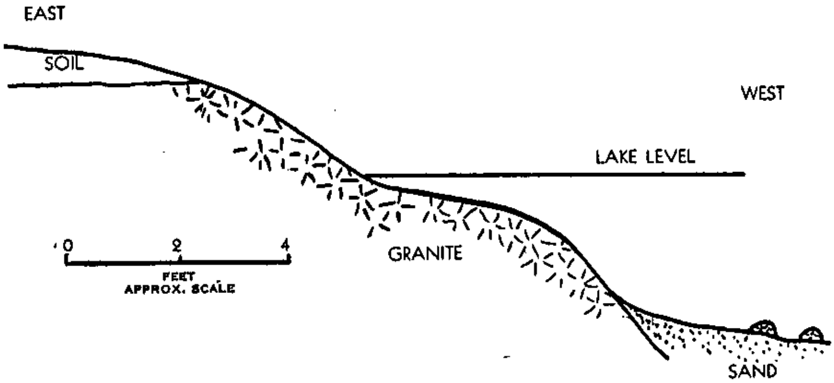

Figure 1. Profile of east shore at Station E_7.*

*Indicated on map.

Lake borders Little Averill Lake on the north, and rises sharply from the shore. Ridges and mountains also border the west and south shores of this kidney-shaped lake, thus giving an ampitheater effect. The water surface of the lake is nearly 8000 sq. yds. in area.

The largest stream flowing into Little Averill Lake, and the only one with an appreciable flow, enters the lake in the middle of the northwestern beach. This stream drains a part of the amphitheater behind this beach, and has a large floodplain with meanders and swampy areas. Timber falls of drowned trees dominate the higher portions of the swamp. The banks of the main stream channel and two abandoned channels are typically higher than the rest of the floodplain. The lower 400 yards of the stream are at grade and the velocity very low.

The other streams shown on the map all have sand deposits across their outlets and are either completely dried up during the summer months, or do not have sufficient flow to cut a channel to the lake. Consequently, their water ponds behind the sand bars and seeps through the sands very slowly. There are some evidences that these beaches are breached briefly during periods of sudden, heavy precipitation, and then silted up again.

The outlet in the northwestern corner is almost completely blocked by sand, boulders, driftwood, and the remnants of a dam wrecked by ice jams. As a result, the water level of the lake is about five feet higher than it normally would be without the dam. When this dam was functioning, it raised the water between 3 and 4 feet above the present level, a factor that helps to account for the higher than average sand beaches. The outlet stream flows over a 6-foot waterfall immediately below this dam.

Little Averill Lake has no bedrock exposed at the shore, but a distinct beach of boulders, cobbles, or sand completely surround the lake.

Along the steep eastern slope, opposite the deepest water, the beach is composed of compact, weathered, ellipsoidal shingle from 6 to 12 inches in diameter, interspersed by rounded boulders of all sizes. The southern beach consists almost entirely of rounded granitic talus boulders averaging 7 feet in diameter. Along the western shore, in the southwestern corner, are found the largest boulders of the area, ranging from 10 to 12 feet in diameter. These stop abruptly where a narrow pebble (¼ to 1½ inch size) and sand beach continues to the north until it, in turn, grades into a crescentic-shaped beach of fine, white sand at the northwest corner. This beach averages 4 to 5 feet above water-level and is between 20 and 30 yards wide by 500 yards long.

The white sand is clearly visible out from this beach to depths of 15 to 20 feet, and by sounding it was determined that this firm sand continues at a gradual slope to the 40-foot depth contour where the bottom drops off sharply to deeper water. The channel of the stream entering the lake through this beach can be traced along the bottom for at least 50 yards before it disappears (Fig. 2). It is quite sinuous or meandering until it starts breaking down into distributary branches.

The northern beach consists of small- to medium-sized, rounded boulders with occasional small areas of gravel or cobble. These boulders, like those generally around the lake, are mostly granitic, but do not seem to be derived from any one source. There are none of the flatiron boulders so typical of Big Averill Lake.

Submerged sand extends almost completely around the lake except along the eastern shore where shingles and cobbles descend steeply into the deepest water. The bottom of the deep-water area is similar in shape to a flat-bottomed bowl. The configuration of the bottom near the outlet, especially as shown by the sand deposits, may possibly be the result of a combination of stream current and wave transportation.

The most effective winds come from the south and the west, the latter direction presenting less interference because of a depression. However, the strongest winds blow from the south. Several small cusps were observed to change rapidly with a shift in the wind along the northwestern beach. One of them, about 2 feet long and 3 inches high, was completely removed by a west-northwest wind in about three hours. Deposits of wood chips are numerous in the still water at the outlet.

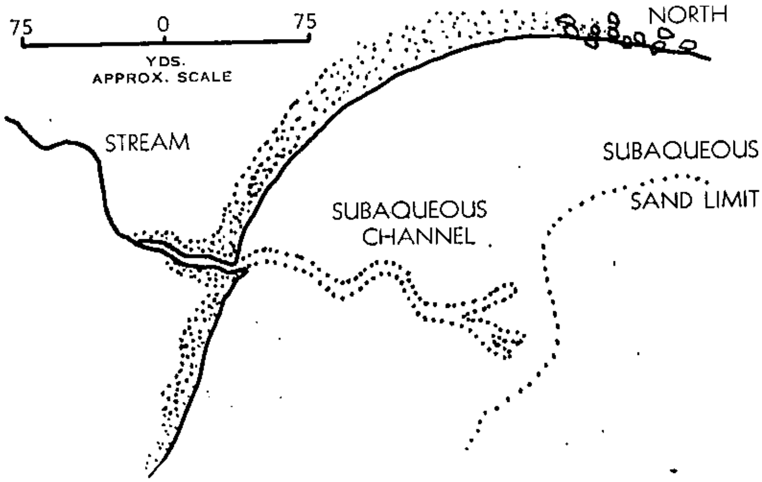

Figure 2. Sketch of stream-crossing northwestern beach.

Island Pond (Lat. 44°47′ Long. 71°53′)

Island Pond (Plate 4) is an irregularly shaped lake whose maximum dimensions are 1200 yards wide by 3000 yards long. It lies 50 yards south of the village of the same name, and is situated nearly a mile from the nearest mountains or ridges. The lake is bounded by a moraine of glacial till and sand bluffs, with valley bottoms, swamps and small ponds common in the surrounding area.

Island Pond is fed principally by several small streams, although underwater springs and seepage contribute. Most of the streams enter the lake from the south and east, draining the lowlands to the south and east. The outlet from the lake is the source of the Clyde River, which flows from the extreme northern corner.

The northern end of the lake has been modified considerably by fill. The outlet, which apparently was once dammed, appears to have silted up rapidly. One 4-foot square block of cement in the center of the outlet

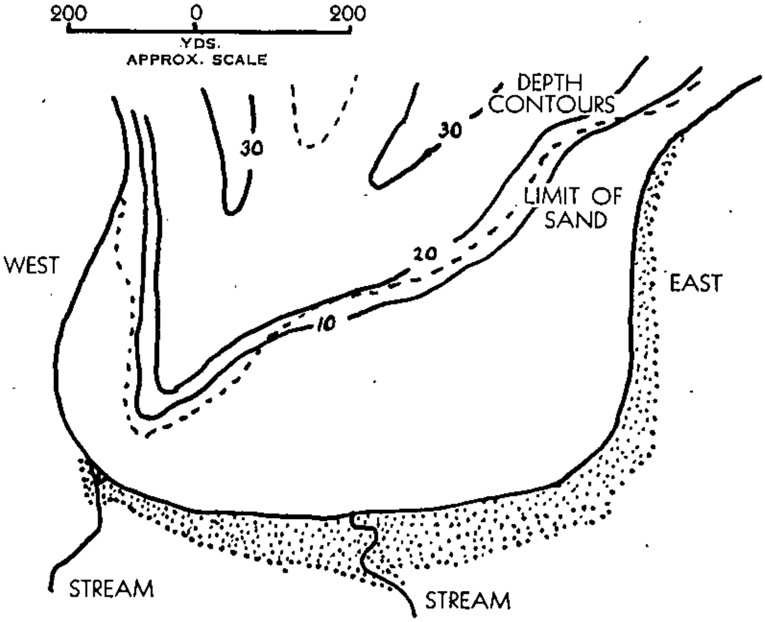

Figure 3. Southern portion of the lake showing nature of the bottom.

is all that now remains of the dam. The channel away from the lake, and the outlet as well, are choked with a great deal of debris. Lying across the mouth of the outlet is a bar of coarse sand whose grains are coated with iron oxide. This coating rubs off easily and is apparently caused by the large amounts of scrap iron lying on the bar and in the adjacent area.

A narrow beach, ranging from 2 to 6 feet in width, which is composed of medium to coarse unsorted sand with stretches of gravel or cobble and occasional small boulders, extends along the western shore. This shore is low-lying meadowland with till bluffs fronting the lake in the center section. Sand beaches, along with scattered boulders, lie at the base of these bluffs.

From the southwestern corner, where a small stream makes an abrupt boundary between sand and boulders, the crescentic-shaped southern beach grades from a medium fine sand to a coarser sand and pebble mixture as it progresses along the southeastern and eastern shore. The beach is approximately 60 feet wide by 800 yards long and shelves from a height of 4 or 5 feet.

Sand deposits extend over 100 yards offshore from the southern beach so that in the southeastern section the water is less than 10 feet deep for nearly 300 yards from shore. At the 10-foot depth contour line the sand drops off into water of an average depth of 27 feet. There is a pronounced indentation in the southwestern corner of the shoal in the vicinity of the stream entering at that point. A sketch of the southern part of the lake is shown in Fig. 3.

The eastern shore is a narrow beach backed by high bluffs and, while still sandy, has more cobbles and small boulders than the western shore. The cobbles and boulders have resulted from erosion of the adjacent bluffs. The small pocket beaches found along the western shore are lacking on the eastern shore. There are only three beaches in the entire length of the eastern shore, two facing to the southwest and the third facing to the northwest, all protected on the north by promontories. The beach at Station E_3 is small and derives its sediments from a small stream ponded in a small swamp behind it.

The beach at Station E_4, however, is well developed, consisting of fine, white, well-sorted sand. It is crescent shaped and protected on the north by a forty-foot high promontory and backed by sandy till bluffs about 400 yards away. There are small dune-like formations of sand from 2 to 3 feet high along the entire base of the beach, which are covered with scrub blueberry growth. The beach is 50 feet wide by 300 yards long, rising to heights of 5 feet at the top of the dunes. This beach consists of fine, well-sorted sand, thoroughly mixed with coal particles derived from the dust and smoke of the railway yards 1000 yards to the northwest. Narrow bands of coal particles are found all along the beach and in patches in depressions offshore, as well as in layers beneath the surface of the beach.

At its northern end the beach changes rapidly from sand to cobble and boulders bedded in sand below the water line. As there are no streams flowing into the lake in this area, the sands seem to have been worked around from the northern promontory by northerly winds, then piled up on the beach by southeasterly winds which blow across more than 2000 yards of water without obstruction before striking this beach.

One hundred yards to the south of the beach at Station E_4 the outlet stream from Spectacle Pond forms another small and narrow sandy beach. It is possible that this same stream contributes to the larger beach at Station E_4, but this appears unlikely because; a) the stream flow is small and has little velocity, the sediment it carries is fine and silty and deposited immediately upon reaching the lake; b) the beach at the stream mouth is not continuous to the beach at Station E_4, and the underwater sand belt here is very narrow, possibly discontinuous; c) the bottom drops off steeply and sharply between the ends of the beaches; d) the composition and character of the sands are not homogeneous and on the beach at Station E_4 small bands and patches of coal particles are present, which are missing on the smaller beach. There are no pebbles or gravel at Station E_4, but they are common on the smaller beach. Thus, it seems logical that the sands of these two beaches are of different origin.

At the lower end of the promontory north of the beach at Station E_4, a small cusp, hooked slightly towards the south, is developed. In the quiet water behind this hook are patches of coal particles similar to those on the beach at Station E_4. Beyond this cusp the shore is composed of boulders of small to large size (2 to 6 feet in diameter). The switching yards of the Grand Trunk Railway at Island Pond are built on cinder fill all along the remainder of the east shore, making an embankment some 12 feet above water level. The fill has not been appreciably affected as yet by wave action, probably because it is protected from south winds by the island and because it is too close to the northern shore with its buildings to be much affected by winds from that direction. The lake was reduced in size by this fill and depths of 25 feet are found within 15 yards of the embankment. Northerly and easterly winds blow considerable amounts of soot and coal dust from the railroad yards into the lake, as all shores show at least traces of this material.

The Pond derives its name from an island situated near the northeastern shore (Fig. 4). The island is separated from the mainland by a deep channel averaging 200 yards in width and rises about 30 feet above the level of the lake. Its banks are steep and lined with medium- to large-sized boulders from 2 to 6 feet in diameter, with a few still larger ones along the northern shore. At the southwestern corner of the island a cusp is built up with material transported from the northern tip by wave action due to northwest winds. The cusp has a larger northern bay than a southern bay, and is slightly hooked to the south. Its base is about 20 yards across and its point extends some 12 yards from the shore.

Directly south of the island is a large shoal whose axis has the same

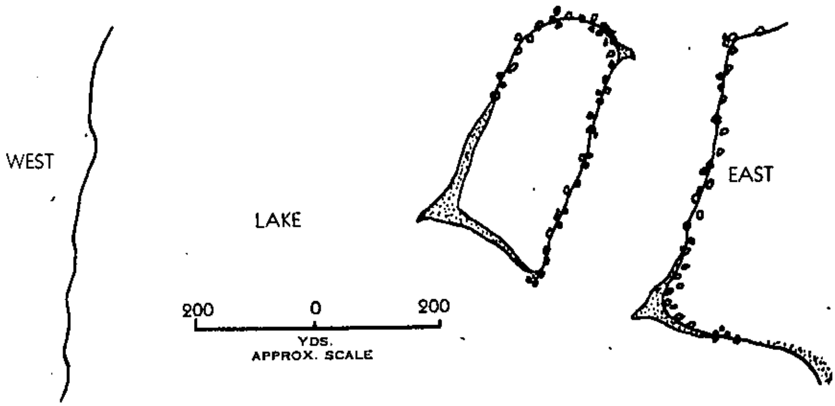

Figure 4. Sketch of the island in Island Pond.

trend as that of the island, i.e., approximately north. The shoal is over 400 yards in length and widens towards the south from 15 or 20 yards to nearly 150 yards. Its northern end shows above water in the form of two large exposures which are either bedrock or very large boulders. They are well rounded and weathered, especially along the joints. Many large and medium-sized boulders surround them a few inches underwater. The water depth increases rapidly from a few inches over these boulders to over 35 feet on all sides of the island except the south. For a distance of 75 yards to the south of the shoal, the boulders become fewer and smaller, and are followed by firm sand about 10 feet below the surface. The configuration of the bottom south of this shoal shows that it is 4 to 5 feet above the 30-foot contour embayments that delineate its boundaries to the east and west.

Like the Averill lakes, this lake contains a considerable amount of sawdust and sunken driftwood. A large number of sunken logs and trees are present, often in water 8 or 9 feet deep. These are common in the indentation of the southern bay where the butt ends of the trees are firmly embedded in the sediments with the tops about 1 foot below the surface. It was not apparent whether these logs represent trees drowned by a change in lake level, or had drifted and sunk there; they appeared to have been cut and trimmed, resembling telephone poles rising from the bottom of the lake at an angle, which seems to be a reasonable supposition.

The prevailing winds are from the north or north-northwest, with occasional strong breezes from the south. Limited experience has shown that high winds usually start blowing about 11 A.M., and by 3 P.M., the lake often is too rough for small boats. The mountains are too distant to afford much protection from the wind.

SPECTACLE POND (Lat. 44°46′ Long. 71°52′)

Spectacle Pond (Plate 4) is a small, shallow T-shaped lake about 1500 yards south and east of Island Pond. The bar of the "T" is 900 yards long by 300 yards wide, the stem 1000 yards long by 300 yards wide. The terrain is like that surrounding Island Pond, i.e., mostly till bluffs covered by scrub oak, pines and with low swampy areas between the bluffs.

All approaches to the lake are so choked with debris, dead wood, or swamps that the author was unable to locate any true feeder streams, or even a suggestion of an inflowing current.

The level of the lake is almost up to the soil on top of the low-lying banks, with grass roots, etc., extending below the water level.

The outlet from this lake flows into Island Pond and is almost completely blocked, not more than a 2- or 3-inch depth of slowly moving water flowing out over the two-foot wide exit.

Spectacle Pond has a great quantity of mud on its bottom and an average depth of ten feet of water. The mud is extremely fluid in the upper horizons while in the lower horizons it is much firmer. The mud was measured to at least a 7-foot depth wherever the water was not less than 10 feet deep.

A bed of sand is visible under water all around the edge of the pond, probably extending for a considerable distance beneath the silt. On the southern shore are rocky till bluffs with boulders forming the headlands. Usually small, under-water beaches, wider than the normal sand rim around the lake, project a short distance out from these points.

A single small beach is located in the extreme eastern corner. It is 20 yards long by 4 yards wide and 18 inches high. It slopes gently outward and is covered with silt at about 20 feet from shore. This beach shows two different sizes and types of beach sands in zones parallel to the strandline. The zone about 2 feet from the water line is much coarser and with easily recognizable slate or phyllitic chips in it, and the other zone about 8 feet in the rear is much finer and lacks the slate chips. It is probable that the finer sands have been washed down by rains from the bluff behind the beach and deposited at the base in the zone nearest the strandline when rainwater soaked down into the original beach sands.

NORTON POND (Lat. 44°56′ Long. 71°53′)

Norton Pond (Plate 5) is about 10 miles north of the village of Island Pond, and lies in a long narrow valley between mountains. It is over 4900 yards long by 800 yards wide at its greatest width. The northwestern banks rise steeply toward the mountain, while the southeastern banks are flat lying or gently sloping at the lake.

Large deposits of sand and gravel occur at both extremities of the lake. The deposits at the south end are much higher and more irregular than those at the north end, the latter apparently having been modified by stream action.

Before the earth-fill dam was built at the northern end of the valley, there were several small ponds along the course of the southward flowing Hurricane Brook. The largest of these was Round Pond, which forms the southern bay of present Norton Pond. All of these small ponds and the surrounding low-lying lands are now flooded, but their outlines are shown on the map by the depth contours. The writer was unable to determine whether Hurricane Brook flowed into Round Pond or bypassed it, with Round Pond being fed entirely by two small feeder streams from the south. It is possible that Hurricane Brook flowed south into Round Pond and the main stream flowed to the north.

Since the ponding of water, the bluffs of glacial till, of which much is unconsolidated sand and rounded boulders, have been undercut generally. The sand and shingle supplying the local beaches occurs almost entirely at the bases of these bluffs. The banks of the pond have been worn back and the finer material deposited between the boulders, some of which are 15 feet in diameter. As there is very little current, not much material is removed.

The southern shores of the islands that lie off the northwest shore of Norton Pond are strongly eroded by wave action, leaving large areas of cobbles and boulders at the foot of the bluffs. The sand has been washed along the shores of the islands and deposited between their northwestern extremities and the adjacent northern shoreline.

The southeastern shore of the lake is low with meadowland and secondary forest growth. Along this shore and its bays in particular, as well as in all low-lying areas of the pond, dead tree stumps are common. At a point approximately half way along this shore line a stream has built up an extensive deposit at its mouth, where lily pads and other shallow-water plants grow in great profusion. Farther to the south the banks become steeper, with boulders ranging from 2 to 6 feet in diameter from the moraine bluffs forming the shore line. The bordering terrain is well wooded with pine trees.

The eastern bay at the southern end of the lake is very shallow, not over eight feet in the center and shoaling to six feet across its mouth. It is almost completely filled with stumps and fallen trees. The divide between this bay and Round Pond is about 30 feet high, but very narrow. Its height is irregular, the wind blowing the waves from Round Pond over the low sections and washing the lighter material away, thus leaving only the heavy boulders to mark the divide.

The topographic map of this lake is in considerable variance with the actual features in the field. The small island in the north, which is 15 feet high, is not shown at all, and the peninsulas at the mouth of Hurricane Brook should be corrected to conform to those shown on the map accompanying this report.

LAKE SEYMOUR (Lat. 44°53′ Long. 71°58′)

Lake Seymour (Plate 6) is the largest body of water lying wholly within the State of Vermont. The lake resembles a sock in outline, with the toe pointing west and the heel to the north. The length of the north-south section of the lake is 5200 yards, and that of its east-west portion slightly more than 2500 yards. The widest part of the lake is the east-west section, with a maximum width of approximately 1450 yards; the width of the north-south section averages 1100 yards.

The main north-south basin lies in a valley that has undergone deep glacial gouging. The valley to the north slopes uniformly to the lake and is drained by the main feeder stream flowing into it. Along the eastern shore the land rises steadily at an average rate of 800 feet per mile. This slope has a light soil cover with large patches of bare bedrock and boulder fields. The vegetation consists mainly of pines and other conifers, and is found also along the small streams and ravines. The shore is well wooded. From Station E_3 to the outlet, Lake Seymour is bordered by low mounds of sandy till covered with light forest growth, but, due to extensive building and clearing along this shore, erosion has become more active.

The western shore rises abruptly from the outlet of the lake to a maximum elevation at Station W_4, where the slope rises sharply from 1278 feet at lake level to more than 2000 feet at the top of Mt. Elan. A spur from this mountain descends northward to form Wolf Point whose eastern side rises from the water as a sheer cliff over 100 feet high. The steepest slopes and greatest depth of the lake (167 feet) are located to the east of this spur.

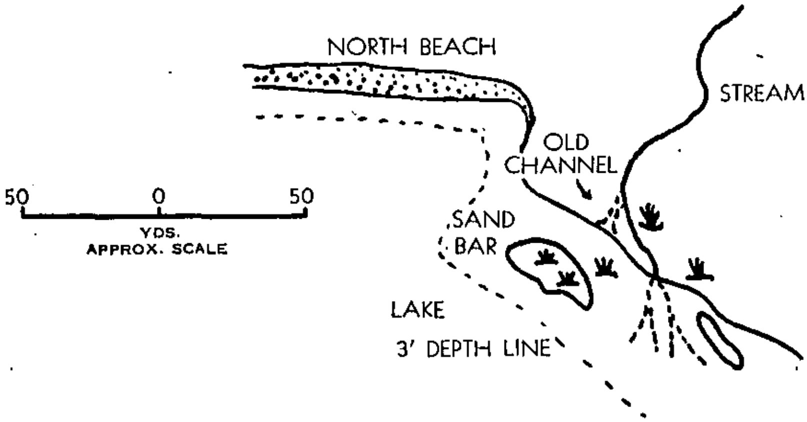

Figure 5. Morgan Center Bay delta.

The terrain surrounding the east-west basin is similar to the east shore of the main basin, with even, gradual mountain slopes in the north and south. The lower slopes and shoreline are well wooded and strewn with boulders. The northern shore in particular is built up with summer cottages. The short western shore of this basin rises steeply at first, then more gradually, and is completely wooded, with many boulders scattered along its ridge.

There are six small brooks and three larger streams flowing into Lake Seymour. One of these larger streams, entering the lake in the extreme northwestern corner of the east-west basin, meanders with low velocity through meadowland in its lower reaches. Much of the sediment carried by this stream is deposited within a few yards of the shore.

The two other larger streams flow into the north-south basin, one at the northeastern corner of Morgan Center Bay (Fig. 5), and the other at Station E_4 (Fig. 6). These streams have built up extensive sand bars and deltas.

The small brooks are not long and flow through meadowland with moderate gradients. All of them have built small sand deposits and bars across their mouths.

Along the eastern side of the north-south extension of the lake, the land rises gradually from Morgan Center to a bluff some 20 feet high directly behind a small sand and boulder beach. This bluff gradually recedes southward from the lake and there are a few exposures of

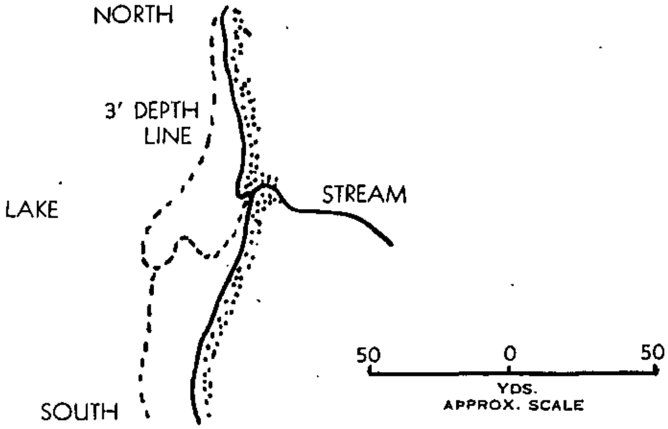

Figure 6. Beach and delta at Station E_4.

granite bedrock, especially at Station E_2. The character of the shore changes to cobble and small boulders with small pocket beaches of sand in sheltered areas. This section of beach is backed by boulders embedded in the bank, which is 4 feet high throughout this area. The cobbles and boulders disappear just south of Station E_1 and low sand bluffs of till occur; the beaches consist mainly of sand and small gravel. The beach and delta figured in Fig. 6 are located in this section, and material brought down by the stream has been carried for a considerable distance along this beach. A small area of boulders extends for a short distance south of this beach, and is succeeded by sand. The small stream that flows into a bay here, continues for nearly 20 yards behind the beach, which is 15 feet wide and 2 feet high, before it finally enters the lake. The western headland of this small bay is composed of medium-sized boulders, but from here to the extreme southern bay the bank is low, with soil, tree roots and boulders behind a narrow sandy strip.

The southern beach is composed of fine, well-sorted sand in which a number of large granite boulders are embedded. An examination of the joints of apparent boulders at Station E_{13}, indicates that the exposure is bedrock in which sand has filled the weathered joints. The joints can be traced from one large "boulder" to the next, for varying distances to their termination.

An extensive underwater sand deposit lies off this southern beach. The 10-foot depth contour outlines this area on the map, and indicates the outlet channel. An examination of the possible sources of this sand deposit and of the underwater contours indicates that the sand was deposited by southward-flowing shore currents along the eastern shore, which are at a maximum from Station E_5 to Station E_{13}. Analysis of the sand samples from these stations shows a gradation from coarser at Station E_9 to finer sands at Station E_{13}.

The natural outlet of Lake Seymour, by way of a small stream that flows into Echo Pond, is controlled by two small dams. The shore immediately west of the upper dam begins to rise and becomes bouldery with small sandy areas.

At Station W_7, the surface rises more steeply and is covered with pine woods, long exposures of granitic bedrock forming the shore line. Where the bedrock is exposed there are no boulders immediately adjacent to the shore, although a few small ones may be seen underwater, offshore. Sand overlaps the bedrock and ends about one foot below the water level. The bedrock rises from the sand with a slight convexity at an angle of about 17 degrees.

At Station W_5, the bedrock terminates abruptly at a sand and gravel pocket beach facing northeast. Sand extends some 20 to 25 feet outward from this beach, becoming increasingly pebbly to the north and also into deeper water where the bottom is almost completely pebbles and cobbles.

Continuing north from this section, the beach is formed of cobble shingle at the base of Mt. Elan which rises abruptly from the pine-forested shore. From the base of a cliffed spur on this mountain to Wolf Point, the shore changes from cobble to large boulders, between which a deposit of white sand shelves rapidly into deep water.

Wolf Point is composed of a highly folded and metamorphosed, sandy phyllite, cut by a large number of resistant quartz veins. A sand deposit composed largely of 60- to 80-inch mesh quartz and muscovite grains forms a hooked cusp at the extreme tip of the point (Fig. 7). As this point is exposed to wave action, particularily from the south and west, careful attention was given to changes in wave direction and their relationship to longshore currents. Winds blowing from the west and

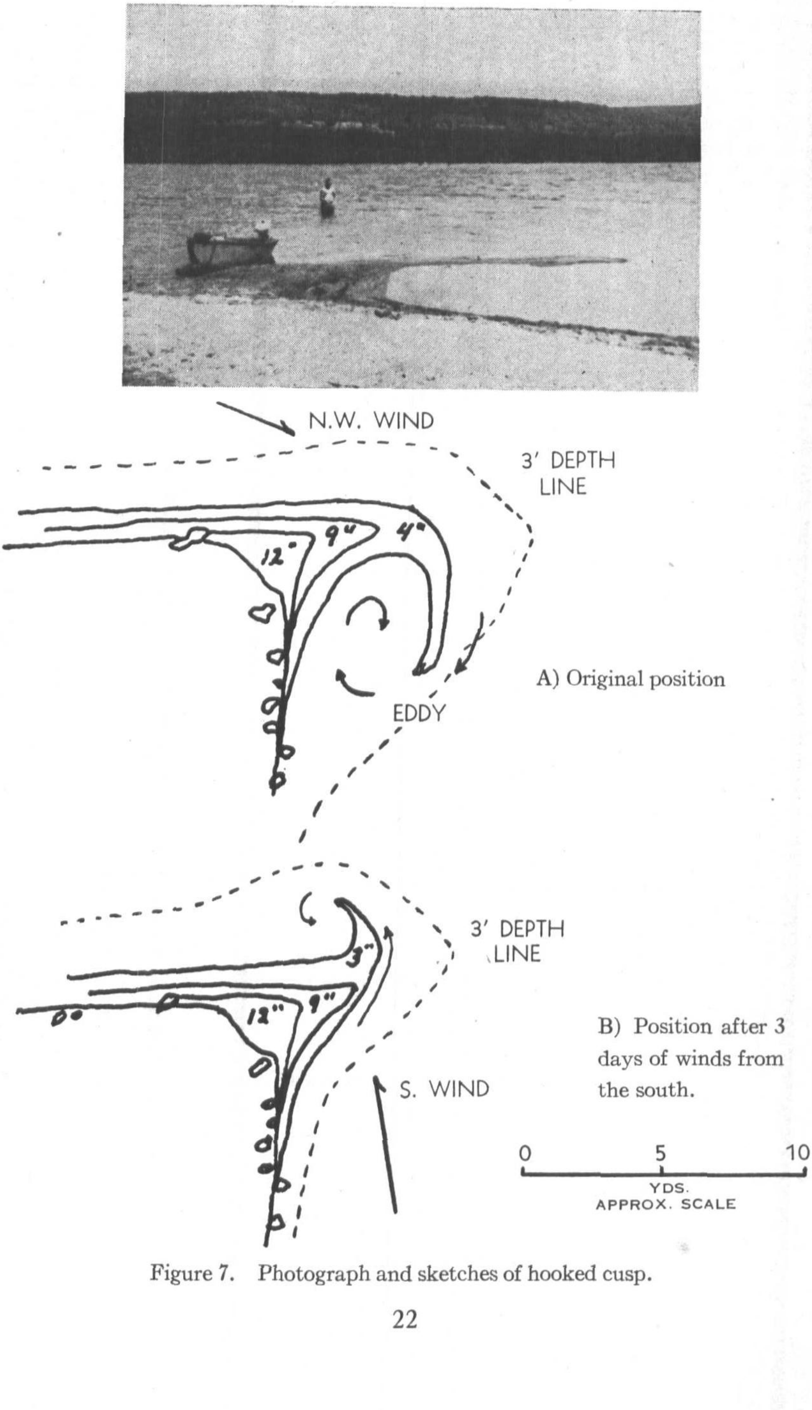

Figure 7. Photograph and sketches of hooked cusp.

northwest from July 13 to 15, had built up an eastward-pointing cusp measuring approximately 20 feet in length to the beginning of the hooked portion, and 23 feet across the base. The base of the hooked part of the cusp was nearly six feet wide, the hook curving sharply to the south for a distance of 14 feet. In the small embayment thus formed, fine mica grains constituted 90 per cent of the sediment. The water in this embayment glistened with slowly settling flakes which were brought in by eddying currents from the north side of the cusp.

After three days of strong southerly winds, July 16, 17 and 18, the hooked portion of the cusp changed its orientation and shape entirely, as shown in Fig. 7. The small embayment with its thick deposit of mica flakes had completely disappeared and strong wave action had washed bands of flakes well up onto the cusp. Sand particles were in rapid motion along the eastern side of the cusp and during a single day over a foot of sand was added to the new tip of the hook. It was observed that the northwest-pointing hooks were always broader and much shorter than those pointing south, the usual length of the latter not exceeding six feet. This difference in length of the cusp may be due to a smaller sand supply, rather than variations in duration of wind direction.

Westward from Wolf Point the surface rises less steeply and the narrow, sandy shore is backed by unsorted boulders and forest. The boulders at Wolf Point are composed of sandy phyllite and granite. The small indentations of the shore immediately west of Wolf Point are narrow sandy beaches with scattered phyllite boulders. The sand extends lakeward for a short distance as a veneer over the phyllite bedrock which forms the floor here. Quartz veins are prominent as small reef-like ridges across this gently shelving bedrock exposure, trapping sand on their lee-sides. The bedrock is highly pitted, resembling the structure of Swiss cheese.

In the extreme southwestern corner of the east-west basin of the lake is a small beach of poorly sorted sands facing to the east. The sand on this beach is derived mainly from an unconsolidated till bluff located directly adjacent and to the north. The northern shore of this basin has many small pocket beaches of sand and pebbles interspersed between large stretches of boulders.

The character, or rather, the topography of the bottom of Lake Seymour is varied. The topography of the north-south basin has been modified by stream and current deposition, whereas the topography of the east-west basin is quite irregular with submerged islands of boulders, sand bars, and clearly-marked channels. The latter basin is considerably shallower than the north-south basin, with a maximum depth in the neighborhood of 120 feet as compared to a maximum depth of 167 feet in the former basin. The underwater slope from shore is gentler in the east-west basin, with no abrupt changes in depth.

In a comparison of both basins it appears to the writer that the north-south basin suffered intensive gouging by the continental ice mass, while in the east-west basin depositional rather than erosive effects appear to be dominant. The present topography of the east-west basin seems to have been produced by stream work, the stream entering the basin in the northwest corner and flowing into the north-south basin just north of Wolf Point.

The underwater sand deposits of Seymour lake, including the limits of muds 6 inches thick or more, are shown in Plate 6. Among the lakes described, Lake Seymour best exemplifies the correlation of sand sources with the currents and wave action set up by the prevailing winds.

Figure 8 shows the prevailing wind directions in Burlington from October, 1947 to November, 1948, and was compiled from the records of the Burlington Meteorological Office. Orientation of this figure with the maps of the lakes will assist in understanding the size and locations of the beaches, but it should be understood that winds are a major contributing factor rather than the determining factor in the location of sand beaches.

ECHO POND (Lat. 44°52′ Long. 71°59′)

Echo Pond (Plate 7) is approximately 600 yards southwest of Lake Seymour. It has the shape of a lima bean and has a normal water surface area of 500 acres. The level of water is regulated by a dam; a fall of five feet in the level of the lake can reduce the surface area by almost 100 acres.

North of the lake the terrain rises rapidly to Mt. Elan, which lies between Echo Pond and Lake Seymour. The lower slopes are well-wooded and boulder-strewn. A low ridge or saddle connects the northern and western ridges; here the slope is gentle and cultivated fields come down to the water's edge. A small stream drains this saddle and, in its lower reaches, flows through a swamp. Its outlet across the beach is partially choked with its own deposits. A ridge rises to the west of the saddle and runs parallel with the western edge of the lake. The east slope of this ridge is steep, wooded, and rocky down to the water's edge,

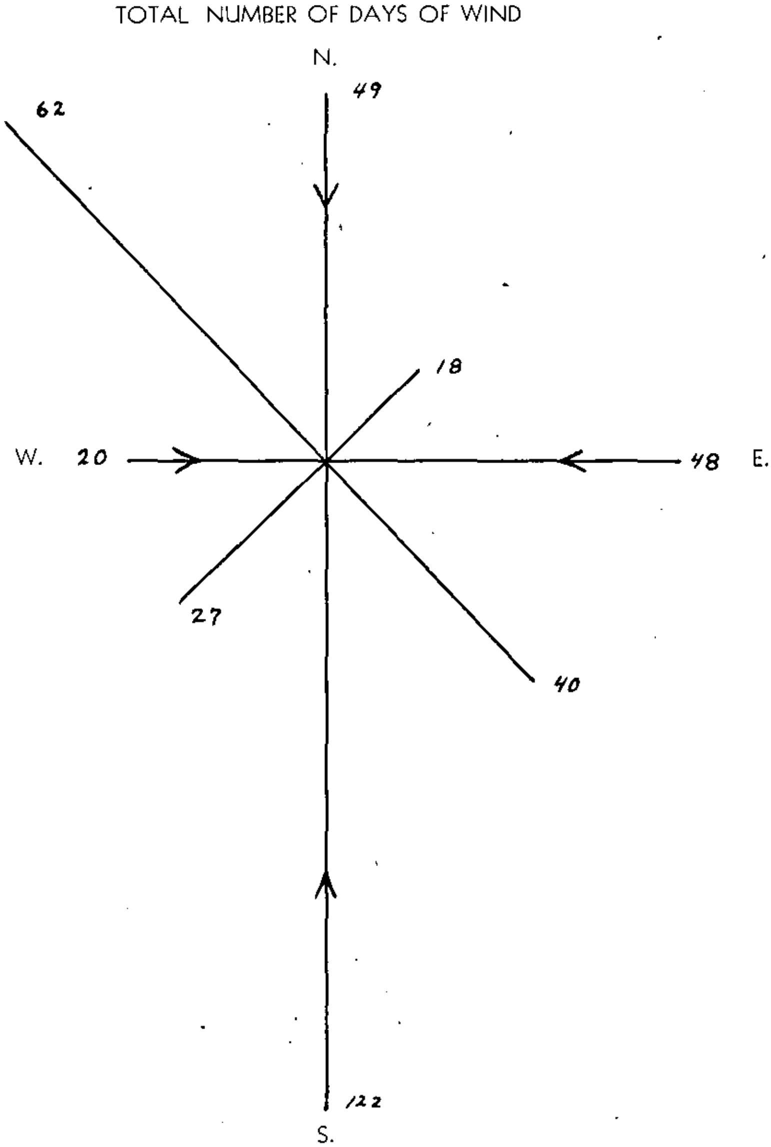

Figure 8. Prevailing wind directions, Burlington, Vt.

but the south slope falls away to a gently rising meadowland forming the edge of the lake. The eastern side of the lake is bordered by a till bluff of protruding boulders at the base of a series of low hills.

The major water supply to Echo Pond is the outlet stream from Lake Seymour, which enters the lake from the northeast. This stream has a gradient of approximately 1:20, and its channel at the edge of the lake is strewn with boulders and well-rounded cobble. Farther from shore, coarse followed by fine sands compose a fan-shaped deposit, presumably a delta, exhibiting well-marked distributory channels of the stream.

Several small brooks enter the lake along the northwestern shore, the largest of them draining the saddle area between the western and northern ridges.

The outlet stream flows from the southwestern corner of the lake where a dam controls the water level.

There are only two natural beaches in Echo Pond, one a crescent-shaped beach along the northwestern shore and the other on the south shore. The northwestern beach has a base of small gravel of ¼- to 1-inch size and coarse sand (retained by 20 mesh sieve), while 4- to 6-inch shale or slate shingle occurs below the water line.

Except for these beaches and a few smaller ones made by residents, the shore line is covered by a continuous mantle of boulders, generally 1 to 3 feet in diameter with scattered larger boulders at intervals. Along the northern shore three of the larger boulders are mushroom-shaped and appear to show the effects of acid swamp water in corroding their bases approximately from 10 to 14 inches deep.

The largest boulders, some of which have a maximum diameter of 12 feet, occur in shallow water near the western shore. The boulders forming the western shore of the outlet channel are from 6 to 10 feet in diameter.

A belt of sand extends completely around the lake and outward to about the 40-foot depth contour. From the 40-foot to the 60-foot depth contour, light mud from 2 to 6 inches thick, covers the bottom. Beyond this belt, which varies slightly in width, the mud increases in thickness and becomes very fluid. The estimated thickness of the fluid mud inside the 110-foot depth line is from 18 to 24 inches.

A small till bluff protrudes slightly from the southeastern shore line, and through wave action and slumping a small shoal has been built up at its base. Another shoal extends northward from this promontory and forms the eastern underwater side of the outlet channel. Soundings taken on this shoal show that it is composed of small boulders well covered by sand.

Still another shoal, which extends northward from the western side of the channel, is composed of large boulders scattered among medium and small boulders covered by sand in deeper water. The shoals on both sides of the outlet channel are above the 20 foot depth contour line, and on the shoal extending northward occasional large boulders show above the water level.

PENSIONER POND (Lat. 44°53′ Long. 72°4′)

Pensioner Pond (Plate 8), measuring 1450 yards by 750 yards, is one of the numerous small lakes found along the course of the northward-flowing Clyde River. Most of these lakes, including Pensioner Pond, are utilized as sources of electrical power.

The surrounding farm land slopes gently to the water, forming low banks of sandy soil with only occasional boulders or gravel.

Along the eastern side of the pond fine sands form a comparatively wide, low beach. A narrower sand beach is prominent along the north and northwest shores, narrowing to about a foot on the western and southern sides of the lake. The soil banks here are only a foot or two above the water level, and at the extreme southern end are hidden by marsh grass and swamp growth.

The Clyde River is the principal stream flowing into the pond and has built a delta at its south end. Since publication of the topographic map, the river has changed its course and now flows into the small bay to the west of its original inlet. Several small streams drain the bowl-shaped terrain surrounding Pensioner Pond, but their contribution is negligible except during periods of heavy precipitation.

Large sections of the bottom are covered with plant growth, especially in the two southern bays and in the shallower waters near shore.

CLYDE POND (Lat. 44°57′ Long. 72°8′)

Clyde Pond (Plate 8), measuring 2000 yards by 350 yards, is the last small lake in the course of the Clyde River and is located a quarter of a mile east of the city of Newport. It is the last of the series of lakes that owe their existence to the dams constructed for power purposes. The lake itself lies in a small valley cut in glacial till and thick deposits of stratified sand. The river has exposed a bedrock cliff along the northeastern shore in cutting through these soft unconsolidated materials.

The flooded channel can be traced easily by soundings, as its course is consistently deeper than its banks by 2 or 3 feet. The original stream flowed over a good-sized waterfall, but now a large cement dam and sluiceway divert the water to the power plant below.

The beaches everywhere here reflect the material directly behind them, varying from fine sands and silt where the old lake deposits are being cut back, to small boulders and cobbles at the base of a cliff cut in till (stations E_3 and W_4). The only exposure of bedrock seen along the shores is in the bluff on the extreme northeast side (Station E_6). There is very little evidence of transportation of beach material and not much sorting either by wind or wave action.

One of the outstanding characteristics of this lake, which is probably due to its brief existence, is the relatively small amount of soft mud found on the bottom. Although widespread, the greatest depth of mud encountered did not exceed four inches. However, as it covers a wide area and considering the short period of time the lake has been in existence, the rate of deposition must be high. The inlet of Clyde River has silted up rapidly in the 20 or so years that the dam has been in place. The deposition at the mouth of the river has been in sufficiently large amounts to form a delta upon which swamp growth has developed. All evidence points to a rapid rate of sedimentation.

The flooding of this area has killed a large number of trees and their stumps and dead trunks are scattered all over the pond, being especially prevalent in the northern and southern portions.

Holland Pond (Lat. 44°59′ Long. 71°56′)

Holland Pond (Plate 9), measuring 2700 yards by 900 yards, is a small irregular-shaped lake that is located approximately one mile south of the Canadian border. Its elevation is considerably higher than that of the other lakes described in this report, which probably accounts, in part, for the unusual fact that it is completely devoid of sand beaches or even exposures of sand, except for one very small pocket in a small bay in the extreme northwestern corner of the lake.

The terrain is thickly forested and, though rugged, rises gently from the shores of the lake.

Four small streams flow into Holland Pond, but their mouths are difficult to locate, as they are obscured behind boulders at water level. The major streams entering the pond flow through swamps at its southern end.

The lake shore is composed of bedrock and boulders, the boulders having the same composition as the bedrock which is a medium-grained granite with white or pink feldspar phenocrysts. The extremely large size of the boulders (some exceeding 30 feet in maximum diameter) made the distinction between bedrock and boulder difficult to determine in a number of places.

As mentioned above, the only exposure of sand above water is composed of very fine-grained white quartz in the northwestern corner. The explanation for its deposition is not readily discernible, as there are no streams entering the small, sheltered bay in which it occurs, and there is not sufficient current or wind action in this narrow, protected northern bay for transportation by wave action.

The boulders along the shore are rounded, probably due to lake ice action and mechanical weathering of the granite. A narrow underwater belt of sand along the shore fills the joints and spaces between the boulders. This sand is much coarser than that found at the beach already described.

Numerous tree trunks, stumps and some driftwood occur in the sheltered bays at the northern end of Holland Pond. These may have been killed by the raising of the water level caused by a small concrete dam. The water in this pond is distinctly brown in color and replete with algae and aquatic plants. It serves as a water supply for the town of Derby.

MAIDSTONE LAKE (Lat. 44°39′ Long. 71°39′)

Maidstone Lake (Plate 10), measuring 3500 yards from north to south by 1350 yards wide, was the southernmost lake surveyed. It is approximately 25 miles southeast of Island Pond and more than 14 miles from the nearest other lake. It is surrounded by amphitheater-shaped mountains rising 3 or 4 hundred feet above the level of the lake. In outline, Maidstone Lake resembles a duck's head with the beak pointing to the southwest. The area is heavily wooded and no attempt has been made to cultivate the land around the lake. The terrain rises steeply from the shore line, which is most commonly a ten- to twenty-foot high boulder bluff.

A single sizable stream flows into Maidstone Lake, entering 200 yards north of the State Park which is located near the center of the eastern shore line, but various small brooks, mostly intermittent, contribute considerable water during periods of much precipitation, particularily those that enter on the southern side of the lake. The level of water is maintained by a dam at the northern extremity. The overflow runs into Paul Brook which extends eastward to the Connecticut River.

Only two small sand deposits occur on the shores of the lake, one which is artificial and was constructed as a bathing beach for the State Park, occupies an indentation on the eastern shore. The other is a natural beach of extremely fine white quartz sand and is located in a small bay at the southwestern end of the lake. This latter beach faces to the northeast and is well sheltered from wind and waves. A possible source of the sand may be a small sandy soil area about 15 yards long at the head of this bay. The minor wave action in this area could be enough to sap and sort the sand.

The remainder of the lake shore is completely lined with boulders of various sizes, mainly from 3 to 6 feet in diameter. Boulders are so common in the shallow water that it is extremely dangerous to run power boats closer than 30 or 40 yards from the shore line. These offshore boulders are consistently large and often awash or within one foot of the surface, in water that is 10 to 15 feet deep. Outcrops of medium-grained granite bedrock occur occasionally, noticeably at Station W_5, between stations E_2 and E_3, and also on two islands.

Although Maidstone Lake is bordered largely by a rocky shore line, an irregular belt of sand along the western side is revealed clearly by soundings taken in the protected bays and along the shores on either side of the outlet. This narrow belt is soon lost off-shore beneath a rapidly thickening layer of mud which is thickest (over 18 inches) where the water is deepest.

There are two islands well above lake level, and several submerged islands or shoals. Both islands have cores of granite bedrock and are surrounded by large and small boulders. The smaller of the islands is in the extreme southwestern bay, close to the western shore. The channel between it and the shore has less than eight feet of water and is choked with large boulders. The larger island, approximately 70 yards from north to south by 30 yards wide, lies some 250 yards from the south-eastern shore. Prominent reefs extend both north and south of this island and are only slightly submerged 30 yards from the shore line. Shallow water, less than 20 feet deep, extends northward from the island for well over 250 yards, but to the south the bottom sheers off much more rapidly. Three hundred yards south of this island, and separated from the reef by a narrow channel whose depth exceeds 50 feet, there is also a shoal whose top, composed of very large blocks of granite, rises to within 18 inches of the lake surface. Between this shoal and the southern shore the water deepens again, but is generally less than 20 feet. However, between the shoal, the island and the eastern shore, the channel opens and depths over 30 feet are found.

The presence of many boulders on the bottom made sounding difficult, particularly in depths of 30 feet or less. Difference in readings a foot or two apart often varied from 2 to 5 feet, depending upon whether soundings had struck boulders or the actual bottom.

The prevailing winds are from the south and west during the summer, varying greatly in strength and persistence. There are no particular areas of driftwood, each embayment having minor amounts. At the northern and southern extremities of the lake a number of large upended logs are either just under the surface or awash, frequently in water over 20 feet in depth. The origin of these large logs was not determined.

Salem Pond (Lat. 44°56′ Long. 72°6′)

Salem Pond (Plate 11) is the largest lake in the course of the Clyde River, appearing as two lakes, the larger measuring 2750 yards by 1450

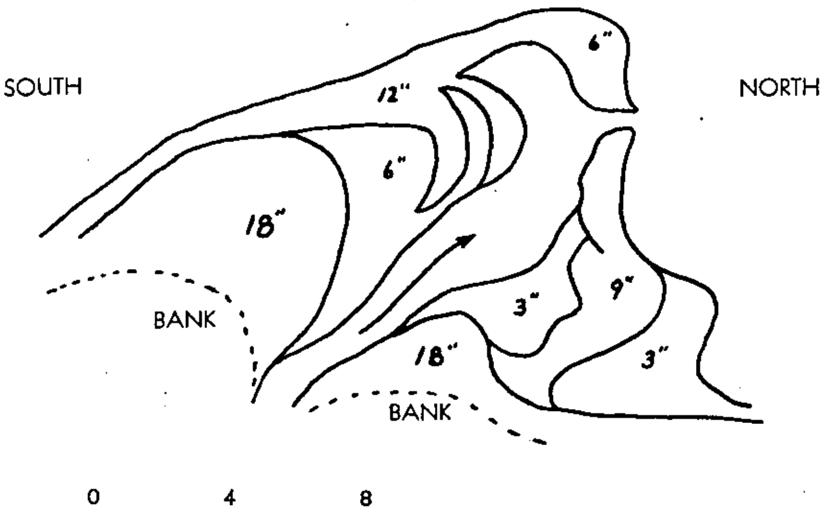

Figure 9. Sketch of sand area at the mouth of stream in the southwestern corner of Salem Pond.

yards, the smaller 1350 yards by 800 yards, both connected by a shallow channel. The lakes lie in an area of ground moraine with sand and till bluffs forming the highest sections of the shore line. The terrain is rolling farm land, rising gradually from the lake.

Four medium-sized streams and seven small brooks flow into Salem Pond. The streams have built up an appreciable number of sand bars and deltaic formations where they enter Salem Pond.

Figure 9 shows the sand formation at the mouth of the stream flowing into the main pond from the southeast (Station E_2 on Plate 11).

The Clyde River has filled in a considerable portion of the southern end of the smaller pond with typical stream deposits and the whole pond is becoming rapidly choked with rushes, lily pads, and assorted water vegetation, which, in many places, is so thick as to seriously impede progress of a rowboat and only with difficulty can a power boat be used. In general, the water is less than 10 feet deep and the bottom is apparently covered with a 10-inch layer of mud, although the mat of vegetation makes this thickness difficult to determine. There are no beaches on the smaller pond, as the meadowland borders the water's edge and forms a low overgrown bank.

The channel between the lakes is nowhere over two feet deep, generally less. Its bottom is mostly ½- to 2-inch gravel with some areas of sand and a few small boulders. Where it opens into the larger pond a sand bar with small low islands extends from the end of a spit across the channel to the western shore. The channel is not well defined here and at no point is the water over this bar deeper than 8 to 10 inches. This sand bar drops off abruptly into the deepest water of the pond, which is 74 feet. In contrast with the other lakes surveyed, the estimated thickness of the mud was much less than 8 inches in this deep area, probably due to the desilting action of the smaller pond.

The shores of the larger pond are generally sandy and for the most part clear of boulders and driftwood. A few small boulders, 1 to 3 feet in diameter, lie at the foot of the low till bluff along the southwestern shore and a 50-yard stretch of cobble lies along the same shore at the mouth of the channel.

Elsewhere along the lake the shore consists of wide sand beaches rising in some sections to over three feet above the water level. The southern beach begins on the east side of the channel as fairly coarse sand mixed with small pebbles, ¼ to ½ inch in diameter. A well-developed sand beach continues along the eastern shore, obscured on the northeast headland by a large area of driftwood. Beyond this headland the beach continues along the northern and western sides of the lake to the boulder stretch mentioned above. The north and south beaches shelve gently from the shore to depths of approximately 6 feet at one hundred yards from the shore. These underwater sand deposits are composed of fine, firm sand. The northern beach, in particular, shelves very gradually from 6 inches of water 30 yards from shore to 3 feet at 100 to 150 yards from shore. In general, the depths do not exceed 6 feet of water within 100 yards from the shores.

Material from the low-lying sand deposits probably accounts for most of the beach material. Deposition is controlled partially by longshore currents created by winds. A secondary but important source of sediments are the streams that enter the lake.

About 400 yards from the eastern shore, toward the center of the lake, is a shoal area of some 250 yards long by 200 yards wide. This shoal is composed of a great number of rounded boulders (1 to 3 feet in diameter) and cobble with little or no sand, which is interesting because elsewhere there are only occasional boulders lying on the shores of the pond, except for the short stretch along the southwestern shore where they have worked out of the bank. Moreover, the shoal is at least 900 yards east of this shore. The water around the shoal averages 24 feet in depth, while the top of the shoal is 12 to 18 inches below the surface. A possible explanation for the formation of this shoal is the erosion of the top of a till bluff, formerly protected from wave erosion by a higher water level. Sand and light materials would be washed away as the lake level dropped, thus leaving the boulders now visible.

Lake Willoughby (Lat. 44°45′ Long. 72°4′)

Lake Willoughby (Plate 12), measuring 8600 yards by 1500 yards, elevation 1170 feet, vies with Lake Seymour for honors as the largest lake within the State of Vermont, but, except for size, they have little in common. Lake Willoughby is long, relatively narrow and certainly the deepest lake in Vermont. Its maximum depth is slightly more than 308 feet. It extends for about five miles in a north-northwestern to south-southeastern direction with the southern portion lying between Mt. Pisgah and Mt. Hoar, whose peaks are over 1500 feet above the lake. Its position between these peaks makes it one of the most scenic and spectacular lakes in Vermont.

Lake Willoughby is apparently fed mainly by springs as there are only 11 small affluent streams. In the month of July three of these streams were dry and the flow from the others greatly diminished. Much water probably flows into the lake through joint systems. The outlet is by way of the Willoughby River at the northwestern corner of the lake.

Lake Willoughby lies almost entirely in a trough cut in granite by

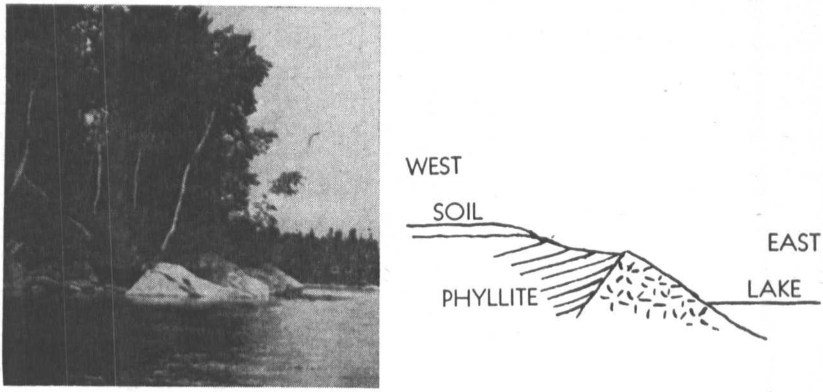

Figure 10. Photograph and cross section of granite-phyllite contact at Station W_6.

glacial action. Along the western shore the contact between the granite and a sandy phyllite (the country rock) is clearly seen in numerous places. The light-colored granite rises above the water some 6 to 12 feet on the western shore and the dark phyllite is visible immediately above and behind it. This contact at Station W_6 is shown in Fig. 10.

This same granite crops out again at Station W_9 and from there southward the country rock moves farther away from the shore and does not reappear again. The bedrock along the shore is often concealed by large granite and occasional phyllite boulders from 5 to 15 feet in diameter. Between stations W_9 and W_{18} and stations E_{18} to E_{10} the shore line is bordered by talus consisting entirely of large granitic boulders.

North of Station E_{10}, the eastern shore is composed mainly of large granite boulders from 3 to 20 feet in diameter and several occurrences of granite bedrock. In the northern part of the lake between stations E_6 and E_1, the eastern shore has one large and several small sand beaches, with occasional patches of pebbles and scattered cobble.

The beach at the northern end of the lake is composed of fairly coarse, poorly sorted sand and small pebbles, which gradually become finer and better sorted offshore. A small sand beach at the extreme southern end of the lake extends for a considerable distance under water and is much finer and better sorted than that at the northern end of the lake.

Midway of the western shore a beach about 300 yards long is dissected by a small stream. As there are no other beaches along this shore, it seems reasonable to attribute its origin to the protected location in a bay and to sediments brought down by the stream.

The configuration of the bottom of Lake Willoughby appears to indicate primary glacial gouging along an old river bed. Later influxes of ice widened and deepened the original channel. The pre-glacial river may well have cut its course through a ridge now indicated by Mt. Pisgah and Mt. Hoar. This supposition is strengthened when the two types of rock present in this area are considered. Continental glaciation would be expected to gouge deepest in soft formations, but here the lake basin is in granite and not in the surrounding softer phyllite.

Subsequent modification of the topography of the lake bottom by stream deposition, especially between stations E_5 and E_6, and by long-shore currents (Station E_4) has not produced major features.

The usual underwater belt of sand lies adjacent to all shores, thinning on the steeper slopes (stations E_9 to E_{17} and W_{17} to W_9) and becoming wider to the north and south ends of the lake. At the southern end, the belt makes a double loop in crossing the lake, while at the northern end it follows the 40 foot depth contour (Plate 12). The deepest areas of the lake have a very considerable thickness of extremely fluid mud. As far as could be determined, this mud was well over 4 feet in thickness. The actual division between water and mud was very difficult to determine.

Prevailing winds are channeled by the surrounding terrain and, consequently, blow most frequently in a north or south direction, and most effectively from the north.

Crystal Lake (Lat. 44°44′ Long. 72°10′)

Crystal Lake (Plate 13), measuring 4400 yards by 1000 yards, lies in a glaciated U-shaped valley, quite similar to that of Lake Willoughby. It is a typical finger lake with its long axis extending for 2½ miles in a north-northwest to south-southeast direction. The southwestern shore of the lake rises uniformly from the water to a 1600-foot ridge parallel to it, while the eastern shore rises precipitously from lake-level at 945 feet to more than 1400 feet in less than 4000 feet of horizontal distance. Much of this rise includes an almost vertical cliff of granite that forms the edge of the lake in some places.

The southern or inlet end of the lake is formed of low hummocks of unsorted till and swamp-filled depressions. Willoughby Brook enters the lake at the southern end and has formed a small delta.

The northern end of Crystal Lake consists of a long crescentic sand beach with the outlet channel at the extreme northwestern end of the beach. The terrain rises gradually from the beach for 500 yards, then the slope increases rapidly to the top of the mountain. A saddle lies between this mountain and the mountain forming the eastern rim bordering the lake.

The eastern shore rises steeply from the end of the northern beach. Glacial action has removed all soil cover here and has rounded the sheer, 200-foot high granite cliff. Two unusual features of this cliff are the total absence of boulders and the depth of the water along its base. The granite rises smoothly and steeply with a slope of 85° from water that has an average depth of 5 to 10 feet.

This prominent cliff extends southward nearly 500 yards and then gradually recedes from the shore. At this place, large talus boulders form the shore line and the slope is more gentle. A small point of sand juts out just south of this boulder section where the ridge has receded and the shore line is low. A small sand and gravel beach is pocketed between two patches of boulders and two small brooks flow across this flat area to the lake. The southern half of this section is protected from wave action by a retaining wall.

The ridge again approaches the lake and forms a high cliff whose lower slopes are covered by very large talus boulders. The talus slope forms the remainder of the shore line along the eastern side of the lake. Many of the boulders are over 20 feet in diameter and even larger beneath the surface of the water.

The southern shore line is swampy and low-lying, with considerable forest growth on the higher slopes. Sediments brought down by Willoughby Brook have built out a large area that completely covers the southeastern bay. This deposit is composed of sand overlain by thin silts from 1 to 6 inches thick. The depth of the water over this deposit varies from 1 or 2 feet near the southern bank to 6 or 7 feet opposite Station E_1. A few boulders make a small headland that divides the southern end of the lake into two small bays. The western bay has a 60-yard long sand beach on its eastern side, while its center and western sides are composed of gravel, cobble and small boulders washed out of the low till bluff behind the beach.

The western shore is bordered by a narrow strip of meadowland in its southern and central sections. The shore line displays stretches of coarse sand and gravel and patches of small boulders, neither exceeding five feet in length.

Between stations W_4 and W_3 is a narrow stretch of fine sand with occasional embedded boulders. This sandy area has a slightly cuspate appearance, which becomes very strongly developed under the water and extends over 100 yards into the lake. The deposit consists of fine white quartz sand (40 to 60 mesh) lying less than 10 feet below the surface. At the northern end of this cusp-like formation, the shore line again consists of boulders with diameters between 2 and 6 feet. Farther north these boulders are consolidated into a railroad embankment that continues beyond the outlet stream in the extreme northwestern corner of the lake.

SUMMARY

The lakes studied can readily be divided into two main groups; one, those located in glacial moraine deposits; and two, those located in glacially gouged rock basins.

The first group, includes Island Pond, Spectacle Pond, Pensioner Pond, Salem Pond, Clyde Pond, Norton Pond, and possibly Echo Pond. A summary of the characteristics of these lakes would include relatively low, irregular shore lines of glacial till, boulders, and sand bluffs with similar terrain immediately adjacent to the shore, while the highlands are comparatively distant from the lakes, generally with sandy beaches along all shore lines, and a persistent subaqueous belt of fine sand along all shore lines and islands.

The streams have built up small sand deposits across their mouths where they lose their velocity upon entering the lakes; these deposits are constantly changing shape as variations in stream flow and material in suspension take place and the direction of prevailing winds is altered. During periods of little precipitation the consequent drop in volume and velocity of the streams, plus the reduction in level of the lake itself gives rise to the formation of bars across the mouths of the streams, resulting in ponding and downward seepage through the sands. An increase in precipitation will cause the stream to break through the bar and establish a new channel. These channels invariably show a deltaic pattern for varying distances from shore. Prevailing winds and their resultant lake currents are major factors in the distribution of sediments brought in by the streams and produced by wave erosion of the sandy till on the shores and islands.

Deposits consisting of two major sizes are distributed at the mouths of these streams. The coarser deposit is directly related to the reduction of stream velocity by the lake waters. The coarser sands are almost 12% by weight more prevalent in the sands deposited close to the mouth of the stream, while the finer sands are predominant in the deposits in deeper water. The finer deposit is the result of stream work and shore currents operating roughly at right angles to stream flow. The combination of these forces shows a characteristic size distribution of sand along the shores adjacent to the stream mouths. The 20- to 80-mesh (U. S. Standard Mesh Screens) sizes grade in that order along the shores in the direction of lake current flow. The finer sand sizes are carried in small quantities into deeper water by the streams and deposited there. During periods of high winds, wave action saps the till banks and washes unsorted material onto the beaches, sorting becoming much better lakeward.

The topography of the bottoms of the lakes in this first group is characterized by even, gradual slopes to deep water. A number of the lakes show irregularities in the forms of shoals and submerged bars, possibly the remnants of eroded till bluffs. These lakes are much shallower than those in group two; excluding Echo Pond, they are all under 75 feet in depth.

The second group of lakes includes Big and Little Averill lakes, Lake Seymour, Maidstone Lake, Holland Pond, Crystal Lake, and Lake Willoughby. Their characteristics include higher banks generally composed of boulders and/or bedrock, steep ascents to ridges or mountains adjacent to the shore line, and small areas of glacial till in some sections along the shore lines. The subaquecus belt of sand is present but much narrower along the shores of these lakes, shelves rapidly, and is not as consistent or persistent as it is in the lakes of group one.

Entering streams flow through two types of terrain, one type, after a steep short course, entering the lake through boulders with very little sand deposits in evidence, and the second type, flowing, in its lower reaches, through areas of glacial debris and till similar to that found surrounding the lakes in group one. The sand deposits off the mouths of the streams of type one show good size gradation in the larger sizes of sand, but the velocity of the streams is usually sufficient to carry the finer sands out into deep water where it is deposited. As the amount of sediment carried by these streams is small, not much sediment is carried along the shores by lake currents. However, the sorting is better as the banks of bedrock or boulders do not contribute much additional sediment to the beaches. The second type of stream builds up sediments in a similar fashion to that of the streams flowing into the lakes of group one.

Except for Norton Pond, wind-driven shore currents are more active in the larger lakes of group two, and the coarser sands are carried much farther along the shore. The degree of sorting increases along the shores lined by boulders or bedrock and beyond sections of till. This is shown particularly well in the size gradation southward from the stream entering Lake Seymour at Station E_9.

The topography of the bottoms of the lakes of the second group is quite different from that of group one. The bottoms are characterized by steep descents, especially in the area immediately adjacent to the greatest depths. There seems to be no correlation between the location of the maximum depth and the highest or steepest cliffs on the shore. A controlling factor of the glacial gouging may have been the courses of rivers flowing over this area during pre-glacial time. Lake Willoughby, in particular, suggests this possibility.

The steep sides of the deep areas shelve at their bases and the areas of maximum depths are relatively flat, resembling the bottoms of U-shaped valleys. Reference to the maps will illustrate this striking similarity.

While the characteristics outlined above summarize the two major groups of lakes, it should be noted that there is an overlapping between the two groups. This is particularly evident in Echo Pond where the eastern and northern sections appear to belong in the second group, while the western and southern sections appear to belong in the first group. Holland Pond has the typical boulder and bedrock shore line of group two, but it is too shallow to possess the remaining characteristics of group two, except, possibly, for the very narrow, discontinuous subaqueous sand belt.

The subaqueous gradation from sand to thin mud, to thick mud in the deeper parts, is consistent in all lakes, except Salem Pond, in which the smaller portion of the lake south of the narrows has acted as a desilting basin for the larger portion.

Histograms showing the percentage size distributions of lake sands of the two groups and the average of all lakes are shown in Plate 14. The lakes of group one show a higher percentage of finer sands than the average, while the lakes of the second group show a higher percentage of coarse sands. The microscopic inspection of the sand grains in the 60- and 100-inch mesh sizes is summarized in Appendix A. Quartz grains comprise by far the largest percentage of the constituents and phyllite chips and biotite flakes comprise the most abundant dark grains. The samples examined show no apparent correlation of minerals in either type of lake

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APPENDIX A
RESULTS OF SAND SAMPLE ANALYSES

APPENDIX A

I. Procedure for Analyses of Sand Samples

1. Dry
2. Weigh
3. Sieve to 1/16 MM
4. Microscopic inspection of grade sizes #60 to #100

II. Analysis

1. Weight of filter paper: 1.–.35 grams; 2.–.39 grams; 3.–.35 grams
2. Dry weight of complete sample.

	Grams		Grams
1.	3.81	15.	2.65
2.	3.96	16.	4.10
3.	4.15	17.	3.24
4.	3.50	18.	3.01
5.	4.49	19.	3.17
6.	3.84	20.	3.35
7.	2.96	21.	4.01
8.	3.29	22.	3.98
9.	3.14	23.	4.10
10.	3.74	24.	2.77
11.	2.75	25.	2.47
12.	3.95	26.	2:59
13.	2.77	27.	2.41
14.	4.00	31.	3.75
		36.	3.91

INDIVIDUAL SAMPLE ANALYSES

Bottle Number	*Sample Weight*	*Size Screen*	*Retained Weight*	*% Weight*
1.	3.81	10	0.0	0
		20	.48	12
		40	2.05	54
		60	1.05	28
		80	.20	5
		100	.002	
		200	Inf.	1
		270	Tr	
			3.782	100

Bottle Number	*Sample Weight*	*Size Screen*	*Retained Weight*	*% Weight*
2.	3.96	10	0.0	0
		20	.52	13
		40	2.51–	64
		60	.68	17
		80	.20	5
		100	.0034 }	
		200	.0041 }	1
		270	Tr }	
			3.9175	100
3.	4.15	10	0.0	0
		20	:030	.7
		40	1.70	43
		60	1.30	33
		80	.92	23
		100 } 200 } 270 }	.002	.3
			3.952	100
4.	3.50	10	0.0	0
		20	0.15	4
		40	2.24	65
		60	1.00	29
		80	.065	1.8
		100 } 200 } 270 }	.0132	2
			3.4682	100
5.	4.49	10	0.0	0
		20	.0583	1.3
		40	.65	15
		60	3.26	74
		80	.4	9.
		100 } 200 } 270 }	.021	.7
			4.3893	100

Bottle Number	*Sample Weight*	*Size Screen*	*Retained Weight*	*% Weight*
6.	3.84	20	.15	4
		40	1.27	35
		60	1.70	46
		80	.46	13
		100	.039	1
		200		
		270	.037	1
			3.656	100
7.	2.96	20	.048	2
		40	.26	9
		60	.37	13
		80	1:10	39
		100	.70	25
		200		
		270	.339	12
			2.817	100
8.	3.29	10	.058	2
		20	.64	20
		40	1.70	53
		60	.63	20
		80	.15	4.6
		100	.015	
		200		
		270	.007	.4
			3.200	100
9.	3.14	10	.189	6
		20	2.71	89
		40	.09	3
		60	.008	
		80	.007	
		100	.001	
		200		
		270	.018	2
			3.043	100

Bottle Number	*Sample Weight*	*Size Screen*	*Retained Weight*	*% Weight*
10.	3.74	20	1.17	33.8
		40	1.7	49
		60	.52	15
		80	.07	2
		100	.003	
		200		
		270	.003	.2
			3.466	100
11.	2.75	20	.058	2
		40	.45	20
		60	.80	36
		80	.70	32
		100	.195	8
		200	.300	13
		270	.085	3
			2.588	100
12.	3.95	10	.075	2
		20	.35	9
		40	1.00	26
		60	1.21	32
		80	1.01	26.6
		100	.117	3
		200	.038	1
		270	.008	.4
			3.808	100
13.	2.77	20	.24	8.8
		40	2.20	81
		60	.25	9.2
		80	.025	.9
		100	.002	
		200	.007	
		270	.004	.1
			2.746	100

Bottle Number	*Sample Weight*	*Size Screen*	*Retained Weight*	*% Weight*
14.	4.00	10	.30	8
		20	.98	25.8
		40	1.70	45
		60	.62	16
		80	.145	4
		100	.012	
		200	.017	1.2
		270	.032	
			3.806	100
15.	2.65	10	.105	4
		20	.53	20.2
		40	.56	22
		60	.50	19
		80	.378	15
		100	.107	4.1
		200	.265	10.2
		270	.139	5.4
			2.584	100
16.	4.10	20	.32	8.2
		40	3.14	80
		60	.40	10
		80	.04	1
		100	.004	
		200	.006	.8
		270		
			3.910	100
17.	3.24	10	.10	3
		20	1.29	40
		40	1.52	47
		60	.25	8
		80	.034	1.6
		100	.003	
		200	.003	.4
		270		
			3.200	100

Bottle Number	Sample Weight	Size Screen	Retained Weight	% Weight
18.	3.01	10	0.0	0
		20	1.28	43
		40	1.62	54
		60	.072	2.4
		80	.006 }	
		100	.003 }	
		200	.003 }	.6
		270		
			2.984	100
19.	3.17	10	.057	1.8
		20	.250	8
		40	.233	7.5
		60	.750	24
		80	.700	22.2
		100	.670	21.5
		200	.394	12.6
		270	.076	2.4
			3.130	100
20.	3.35	10	.049	1.5
		20	1.420	43.5
		40	.920	28.4
		60	.700	21.6
		80	.158	4.8
		100	.004	.1
		200	.003	.1
		270		
			3.254	100
21.	4.01	10	.600	15.7
		20	1.130	29
		40	1.660	43.5
		60	.400	10.5
		80	.017	.4
		100	.002 }	
		200	.004 }	.9
		270	.007 }	
			3.820	100

Bottle Number	*Sample Weight*	*Size Screen*	*Retained Weight*	*% Weight*
22.	3.98	10	.40	11.2
		20	1.00	28.2
		40	1.43	41
		60	.49	13.8
		80	.160	4.5
		100	.018	.5
		200	.021	.6
		270	.007	.2
			3.526	100
23.	4.10	10	.51	14
		20	1.80	49
		40	.60	16.4
		60	.150	4.1
		80	.264	7.4
		100	.170	4.6
		200	.160	4.3
		270	.004	.2
			3.658	100
24.	2.77	10	.45	20.6
		20	.40	18.3
		40	.62	28
		60	.60	27
		80	.110	5
		100	.007	.3
		200	.012	.5
		270	.007	.3
			2.206	100
25.	2.47	10	.30	15
		20	.72	34.7
		40	.75	35.2
		60	.141	6
		80	.032	1.5
		100	.024	1.1
		200	.093	.4
		270	.107	5
			2.167	100

Bottle Number	*Sample Weight*	*Size Sereen*	*Retained Weight*	*% Weight*
26.	2.59	10	.162	6.5
		20	.701	29
		40	.917	38
		60	.425	17.5
		80	.135	5.5
		100	.027	1.1
		200	.051	2.1
		270	.010	.4
			2.428	100
27.	2.42	10	.226	10.2
		20	.855	39
		40	.917	41
		60	.127	5.2
		80	.027	1.2
		100	.017	.7
		200	.030	1.3
		270	.009	.4
			2.208	100
31.	3.75	10	.565	21.4
		20	1.450	55
		40	.540	20.4
		60	.045	1.7
		80	.012	.4
		100	.010	.4
		200	.010	.4
		270	.008	.3
			2.640	100
36.	3.91	10	.210	6.2
		20	.395	11.6
		40	1.262	37
		60	.950	28
		80	.503	14.7
		100	.072	2.1
		200	.009 }	
		270	.003 }	.4
			3.404	100

SAND SAMPLE LOCATIONS

Bottle Number	*Lake*	*Location*
1.	Island Pond (44°47′—71°53′)	S. W. beach of Island
2.	" "	E_4 beach
3.	" "	E_2 beach
4.	Little Averill (44°57′—71°43′)	N. W. beach
5.	" "	W_2—water level
6.	" "	Outlet, left side—dry
7.	Island Pond (44°47′—71°53′)	E_4—in 1′ H_2O
8.	" "	S. beach
9.	Spectacle Pond (44°46′—71°52′)	2′ from water's edge, E. beach
10.	" "	10′ " " " "
11.	" "	Bluff, 25–50 yds E. beach across RR tracks
12.	Norton Pond (44°56′—71°53′)	Hook spit 100 yds E. of W_7 near Round Pond
13.	" "	Hook spit 100 yds E. of W_7 near Round Pond
14.	Echo Pond (44°52′—71°59′)	Headland, southern bay
15.	" "	" " "
16.	Seymour Lake (44°53′—71°58′)	N. W. beach (west of E_1)
17.	" "	" " in H_2O
18.	" "	Beach, S. bay E_{13}
19.	" "	1′ H_2O, S. bay E_{13}
20.	" "	Shoulder S. bay E_{12}
21.	" "	1′ H_2O, S. bay E_{12}
22.	" " (44°53′—71°58′)	Opp. Ames Park, dry—E_{10}
23.	" "	" " " , H_2O "
24.	" "	Wolf Pt. 75–100 yds W. dry
25.	" "	River mouth spit—E_9
26.	" "	Right of delta—E_9
27.	" "	Wolf Pt. H_2O—W_1
31.	" "	Beach at Professor's Camp
36.	Pensioner Pond (44°53′—72°4′)	E. beach, dry

RESULTS OF MICROSCOPIC INSPECTION

Microscopic inspection of selected samples shows that quartz is by far the predominant mineral. Clear quartz is the prevailing type, but milky quartz is also abundant. Rose and yellow quartz grains are common, along with occasional smoky or black quartz grains. On a few beaches high above water-level rounded grains are fairly common, but, in general, the degree of rounding is slight; almost all the quartz grains are angular or sub-angular.

Small chips of phyllite are the most abundant among the dark grains; they are normally flat and roughly ellipsoidal in outline. Occasionally, however, they are well-rounded, especially in the 60-mesh size.

Biotite and biotite altered to chlorite are almost as prevalent as phyllite chips. In some lakes biotite is the predominant dark grain and is the most common dark mineral in the 100-mesh size, except for samples collected from Island Pond.

Magnetite and Tourmaline are persistent minerals in all samples but rarely in quantities exceeding one per cent. Island Pond, however, shows a high percentage of dark magnetic grains, which may be magnetite. Engine smoke and cinders from the railway yards in the village of Island Pond, is often blown over the lake in quantities and most of the black grains, containing both magnetic particles and coal dust, are apparently derived from this source. Some grains are spherical and resemble furnace slag.

Occasional grains of garnet, zircon, and beryl were observed, but rarely more than one or two grains in any one sample. The garnet grains, in particular, are well rounded and usually pitted. Feldspar grains are not common.

APPENDIX B
DETAILED DESCRIPTION OF MAPPING METHOD

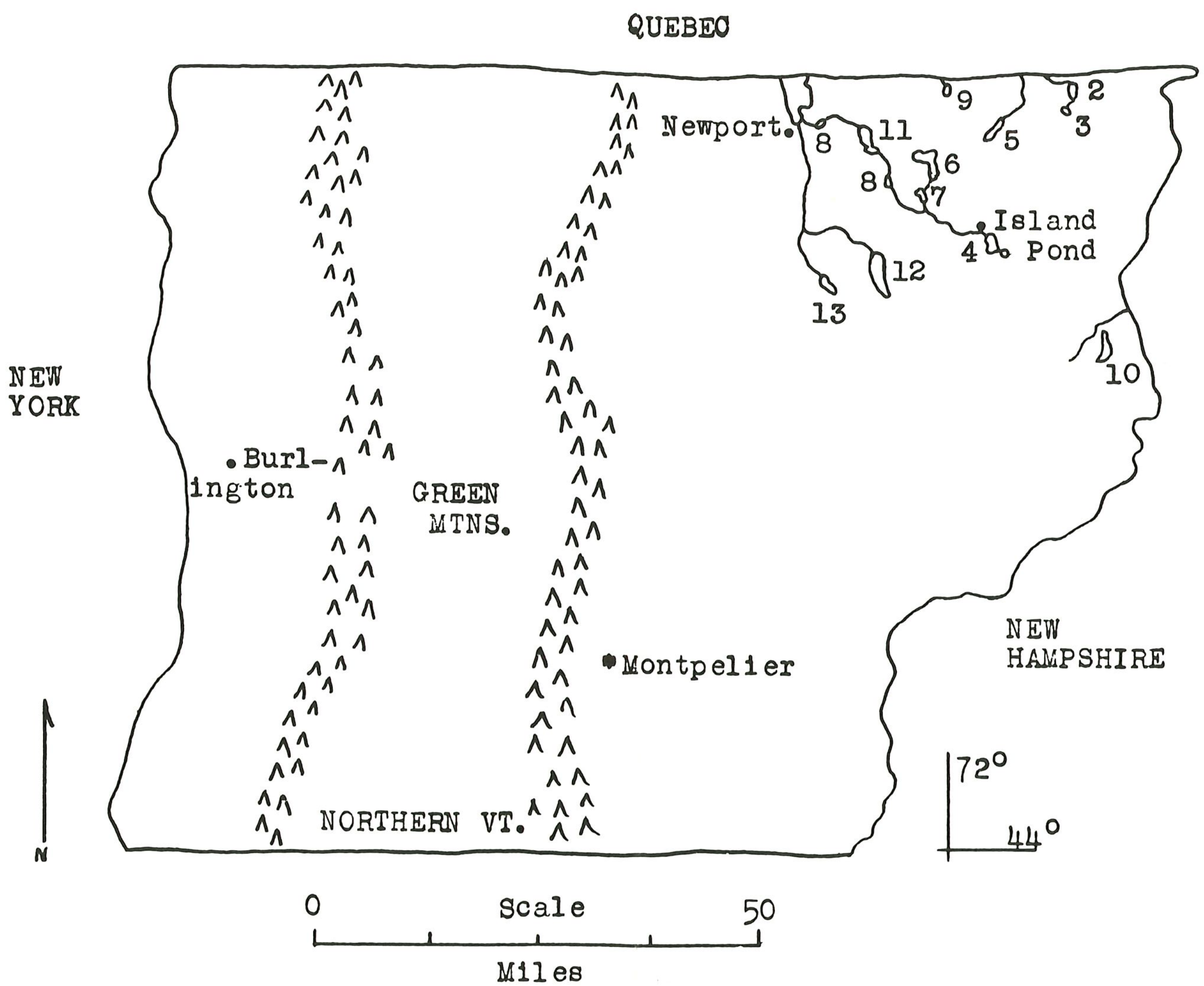
APPENDIX B

Photostatic enlargements of U. S. Geological Survey topographic quadrangles were supplied by the Vermont Geological Survey. Field tracings were made from these maps, including all affluent and effluent streams, swamps, and other topographic features adjacent to the shore line. During the preliminary survey of each lake, shore line characteristics were plotted and flag stations located and checked by compass triangulation. Where possible, prominent irregularities along the shore were chosen as flag stations, otherwise yard-square flags of red cotton were staked out. The distance between flag stations along the same shore varied with each lake, but averaged 400 yards.

The sounding procedure described below was adopted, as it was found to give the most satisfactory results for the amount of time allowed for the survey.

Straight runs across the lake between opposite flag stations were made and soundings taken at 10, 25, 50, and 100 yards from shore. Beyond this point, soundings were taken 100 yards apart to shallower water on the opposite shore, unless a sharp change in the topography of the bottom made it expedient to sound at 25 yard intervals. As the sounding equipment consisted only of 360 feet of rope with a 2-pound lead weight, the writer used a 100-yard length of light line supported at each end by a half-filled bottle and cork floats at 25-yard intervals. The depths were recorded along with the bottom conditions and distance from shore. In using the above method it was found that the computed distance and the map distance checked closely, usually within 20 yards. To insure a straight sounding line the motor-driven boat was circled around each sounding point while the depth reading was taken.

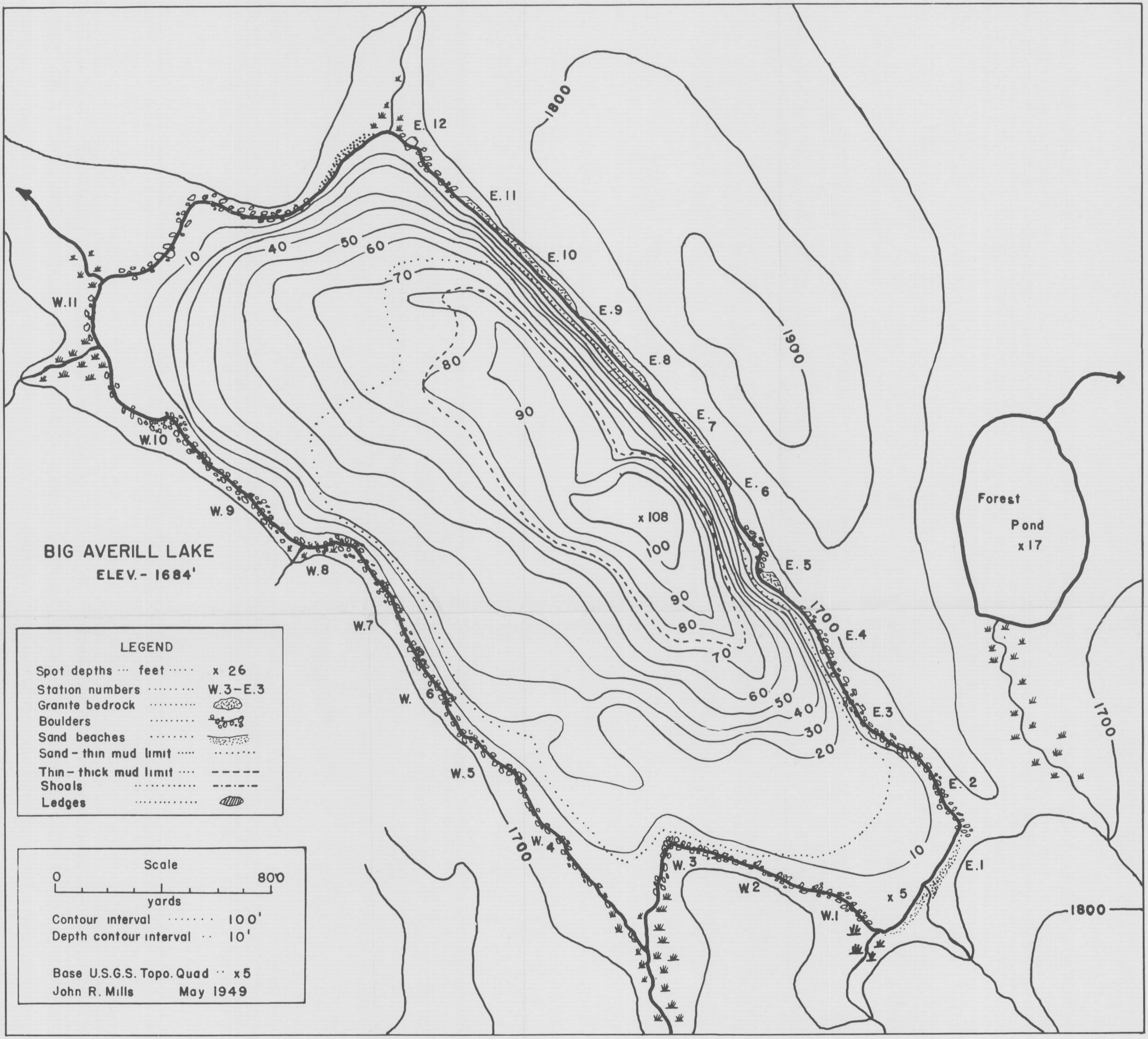
Upon the completion of the day's sounding the data was transcribed onto maps, along with all spot check soundings and any other features noted.

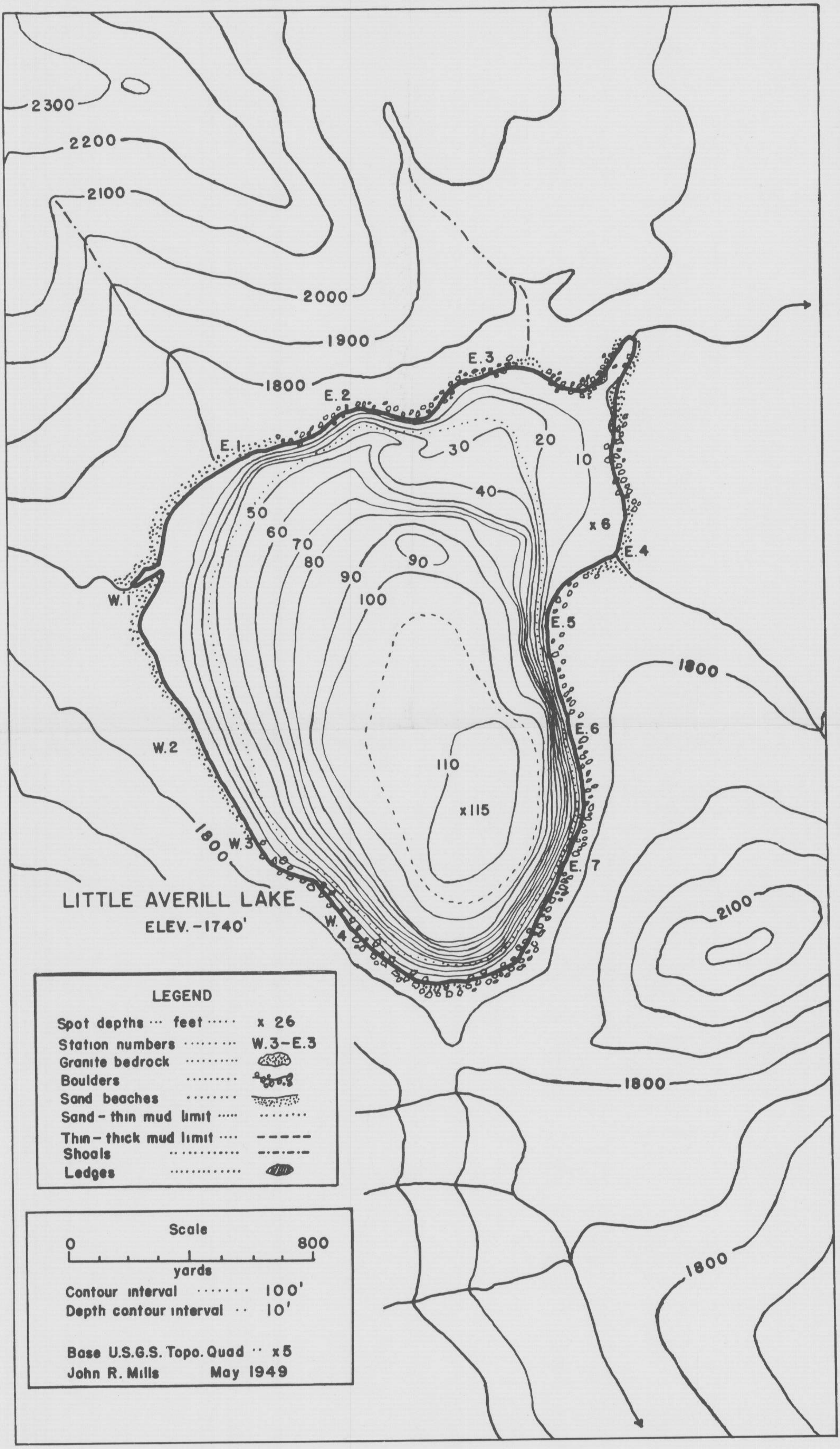


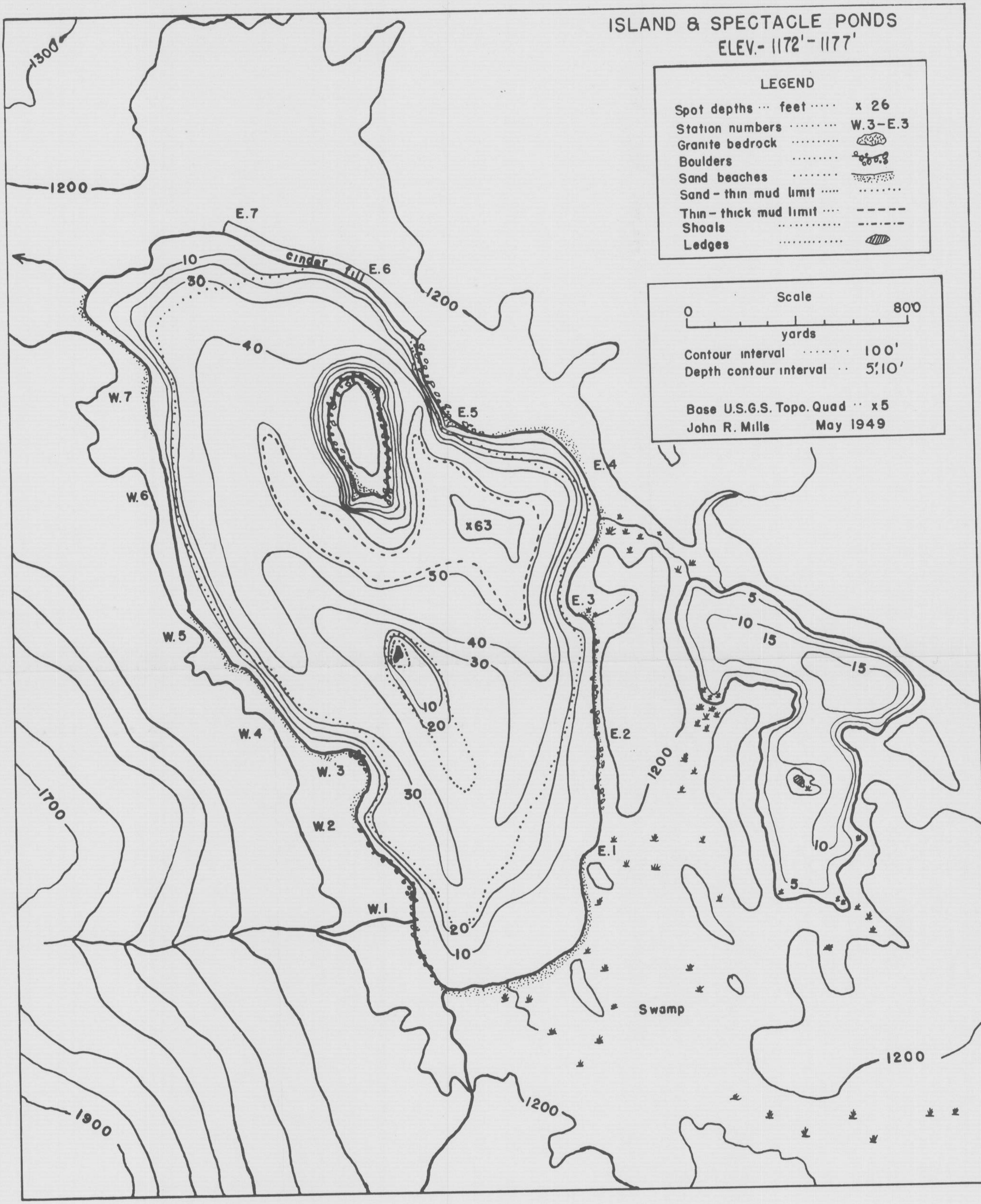
INDEX MAP

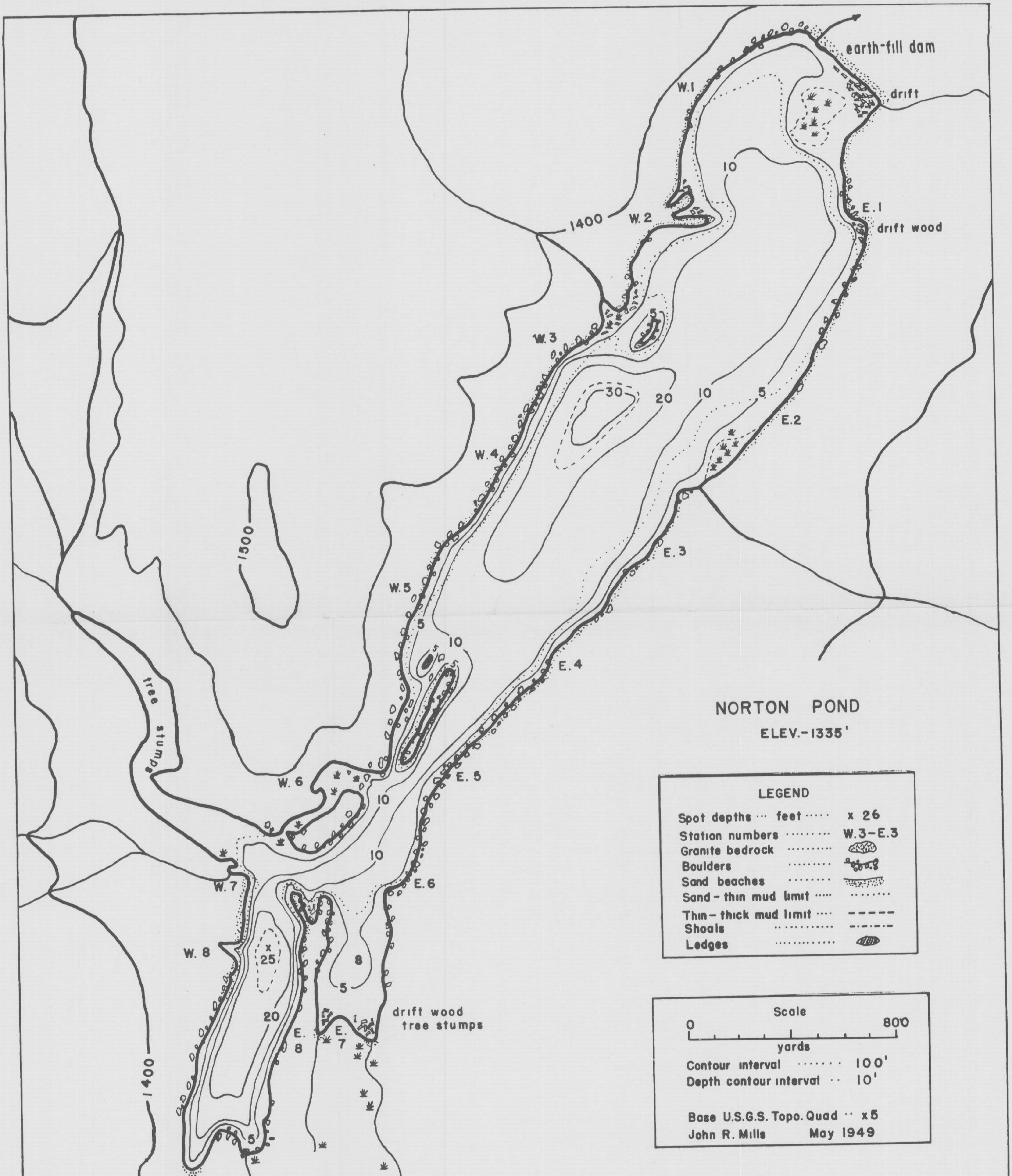
PLATE 1. Index Map
2. Big Averill Lake
3. Little Averill Lake
4. Island and Spectacle Ponds
5. Norton Pond
6. Lake Seymour
7. Echo Pond

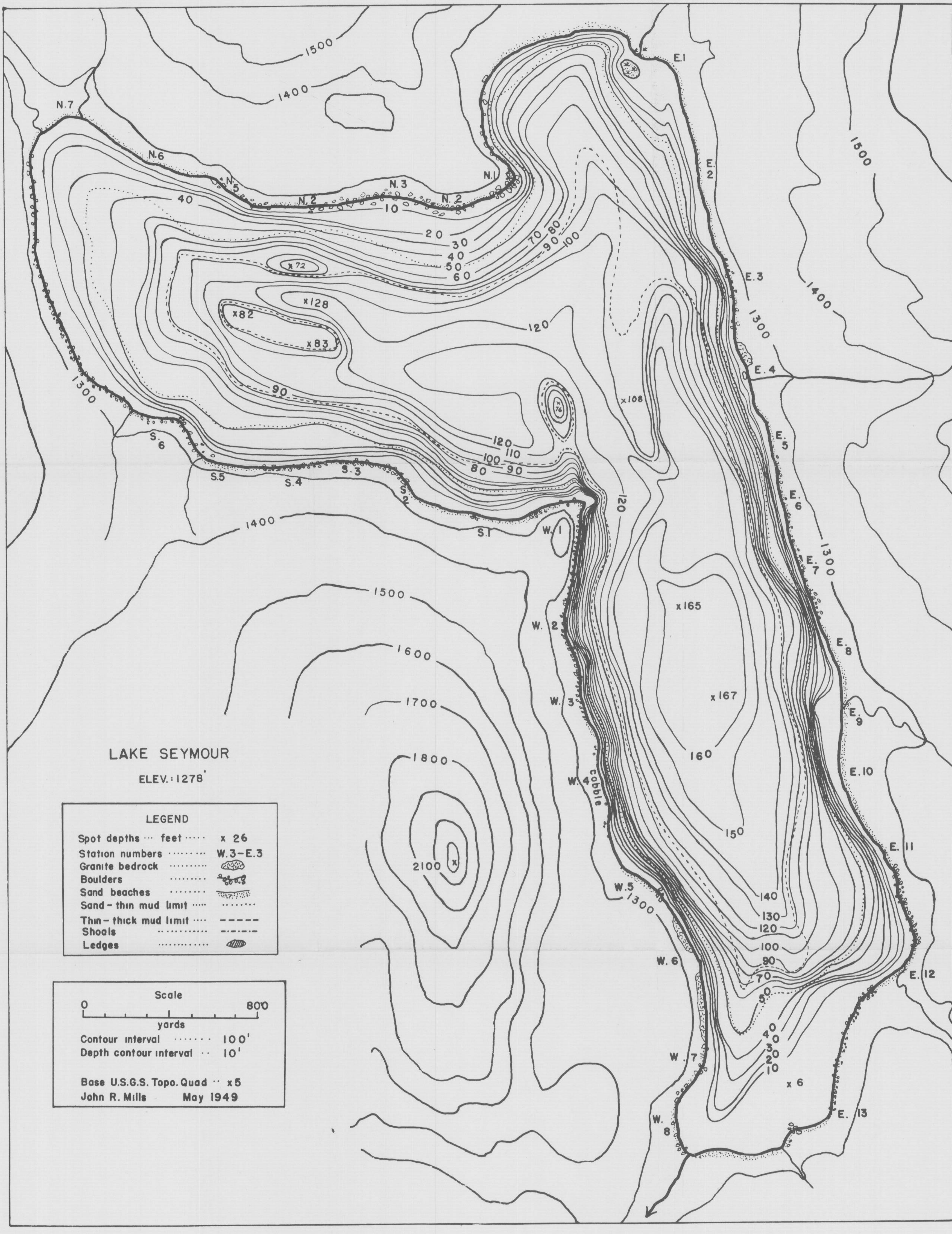
Plate 8. Clyde and Pensioner Ponds
9. Holland Pond
10. Maidstone Lake
11. Salem Pond
12. Lake Willoughby
13. Crystal Lake
14. Histograms of Sand Samples

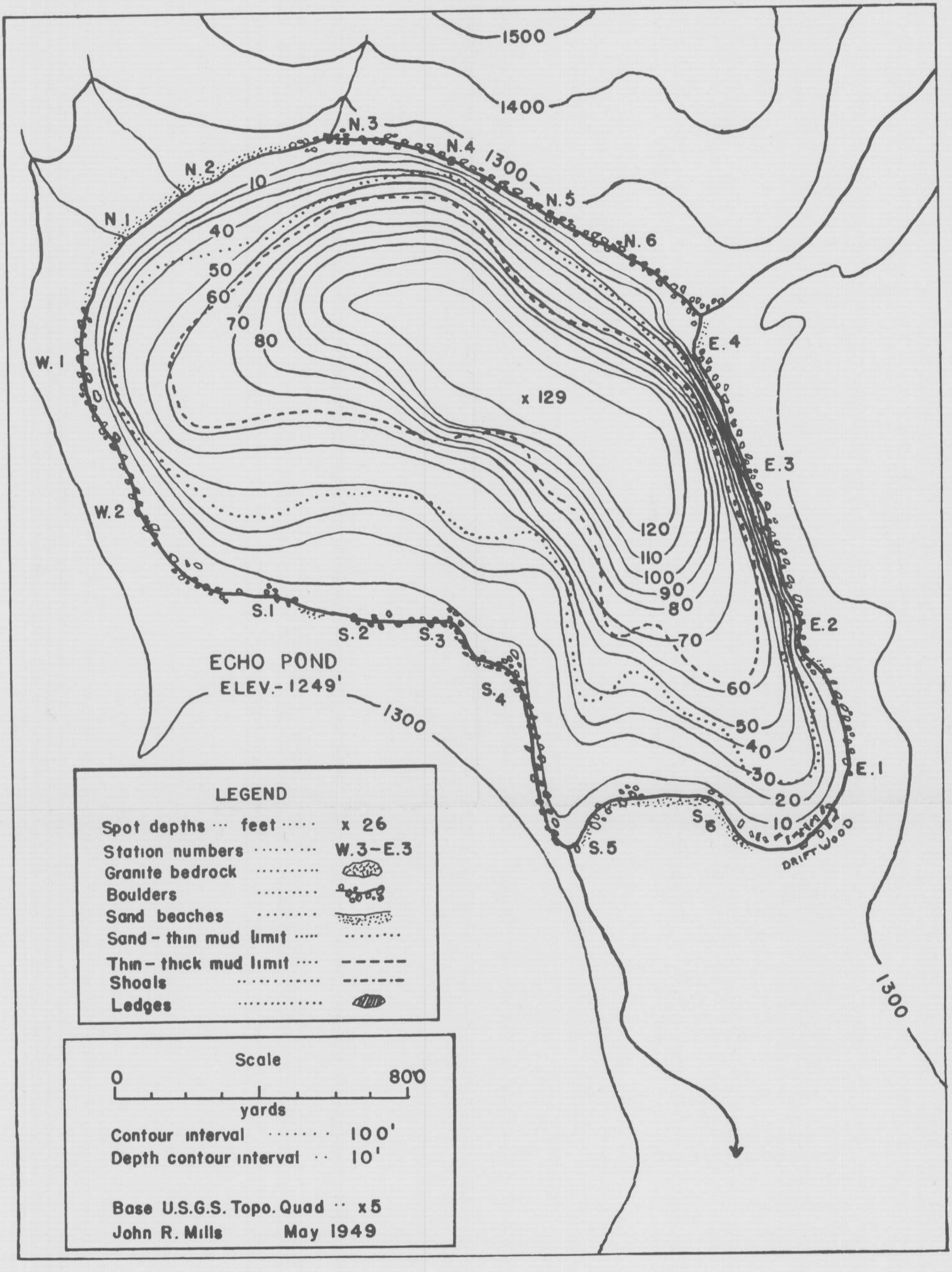

BIG AVERILL LAKE
ELEV. - 1684'
Forest Pond
x 17
x 108
x 5
1800
1900
1700
10
20
30
40
50
60
70
80
90
100
E. 1
E. 2
E. 3
E. 4
E. 5
E. 6
E. 7
E. 8
E. 9
E. 10
E. 11
E. 12
W. 1
W. 2
W. 3
W. 4
W. 5
W. 6
W. 7
W. 8
W. 9
W. 10
W. 11
LEGEND
Spot depths ··· feet ····· x 26
Station numbers ·········· W. 3 - E. 3
Granite bedrock
Boulders
Sand beaches
Sand - thin mud limit
Thin - thick mud limit
Shoals
Ledges
Scale
0
800
yards
Contour interval ······ 100'
Depth contour interval ·· 10'
Base U.S.G.S. Topo. Quad ·· x 5
John R. Mills May 1949

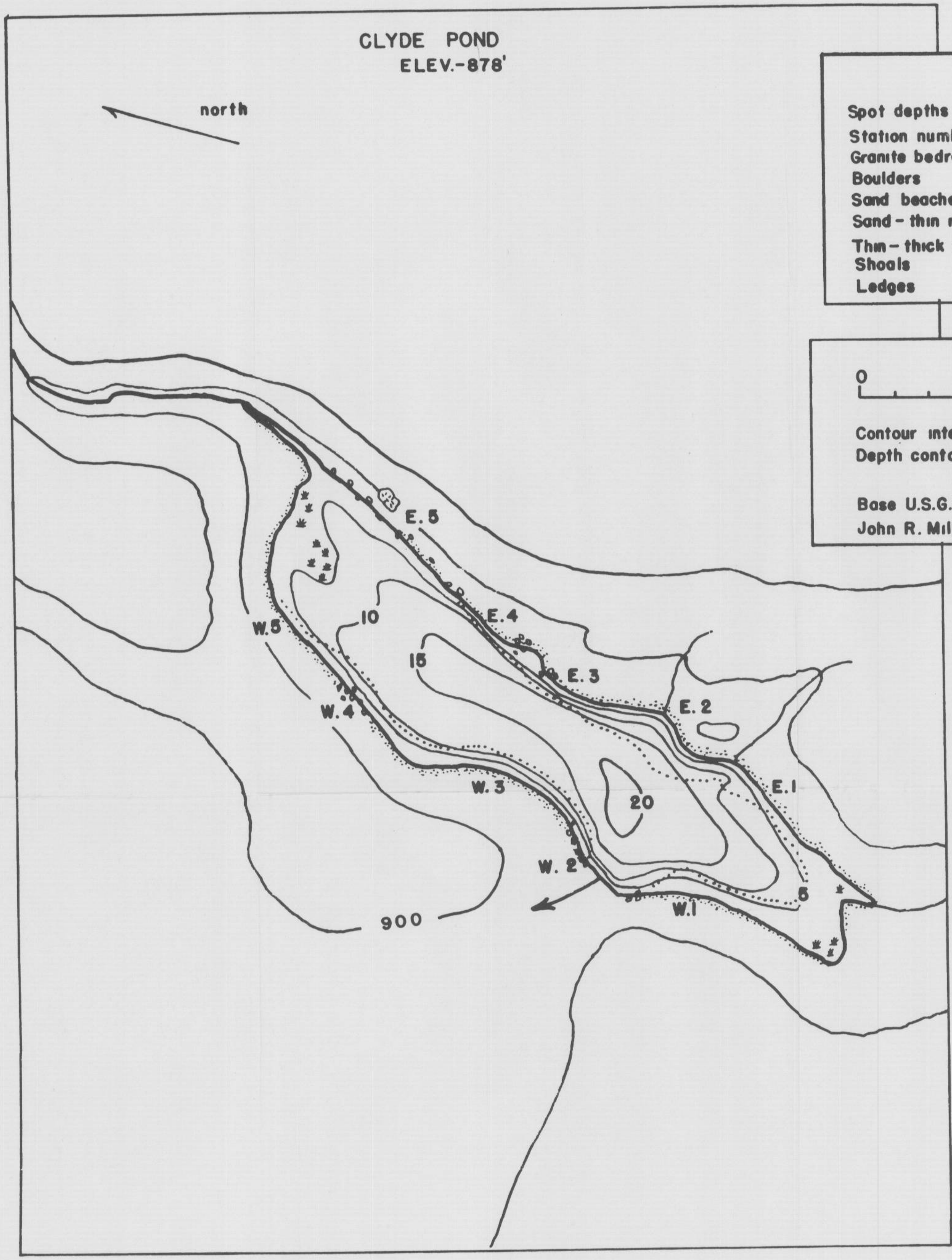

2300
2200
2100
2000
1900
1800
E.3
E.2
E.1
30
20
10
40
50
60
70
80
90
90
100
x 6
E.4
W.1
E.5
1800
E.6
W.2
110
x115
1800
W.3
E.7
LITTLE AVERILL LAKE
ELEV. -1740'
W.4
2100
LEGEND
Spot depths ··· feet ····· x 26
Station numbers ········· W.3-E.3
Granite bedrock ·········
Boulders ·········
Sand beaches ·········
Sand - thin mud limit ·····
Thin - thick mud limit ·····
Shoals ···········
Ledges ···········
1800
Scale
0
800
yards
Contour interval ······· 100'
Depth contour interval ·· 10'
Base U.S.G.S. Topo. Quad ·· x 5
John R. Mills May 1949
1800


ISLAND & SPECTACLE PONDS
ELEV.- 1172'- 1177'
LEGEND
Spot depths ··· feet ····· x 26
Station numbers ········ W.3-E.3
Granite bedrock ··········
Boulders ·········
Sand beaches ·········
Sand - thin mud limit ·····
Thin - thick mud limit ····
Shoals ············
Ledges ·············
Scale
0
800
yards
Contour interval ······· 100'
Depth contour interval ·· 5',10'
Base U.S.G.S. Topo. Quad ·· x5
John R. Mills May 1949
1300
1200
1700
1900
E.7
E.6
E.5
E.4
E.3
E.2
E.1
W.7
W.6
W.5
W.4
W.3
W.2
W.1
cinder fill
x63
Swamp
10
20
30
40
50
5
15


earth-fill dam
drift
W.1
10
1400
W.2
E.1
drift wood
W.3
5
30
20
10
5
E.2
W.4
1500
E.3
W.5
5
10
E.4
tree stumps
NORTON POND
ELEV.-1335'
W.6
10
E.5
10
W.7
E.6
W.8
x
25
8
5
20
E.
8
E.
7
drift wood
tree stumps
1400
5
W.9
LEGEND
Spot depths ··· feet ······· x 26
Station numbers ········ W.3-E.3
Granite bedrock ·········
Boulders ·········
Sand beaches ·········
Sand - thin mud limit ·····
Thin - thick mud limit ····
Shoals ···············
Ledges ·············
Scale
0
800
yards
Contour interval ······· 100'
Depth contour interval ·· 10'
Base U.S.G.S. Topo. Quad ·· x5
John R. Mills May 1949


LAKE SEYMOUR
ELEV.: 1278'
LEGEND
Spot depths ··· feet ····· x 26
Station numbers ········ W.3 – E.3
Granite bedrock
Boulders
Sand beaches
Sand – thin mud limit
Thin – thick mud limit
Shoals
Ledges
Scale
0 800
yards
Contour interval ······· 100'
Depth contour interval ·· 10'
Base U.S.G.S. Topo. Quad ·· x5
John R. Mills May 1949
1500
1400
1300
1600
1700
1800
2100
N.7
N.6
N.5
N.3
N.2
N.1
E.1
E.2
E.3
E.4
E.5
E.6
E.7
E.8
E.9
E.10
E.11
E.12
E.13
S.1
S.2
S.3
S.4
S.5
S.6
W.1
W.2
W.3
W.4
W.5
W.6
W.7
W.8
cobble
x72
x82
x83
x128
x76
x108
x165
x167
x6


1500
1400
1300
N.1
N.2
N.3
N.4
N.5
N.6
E.4
E.3
E.2
E.1
W.1
W.2
S.1
S.2
S.3
S.4
S.5
S.6
x 129
10
40
50
60
70
80
120
110
100
90
80
70
60
50
40
30
20
10
DRIFTWOOD
ECHO POND
ELEV.-1249'
1300
1300
LEGEND
Spot depths ··· feet ····· x 26
Station numbers ········· W.3-E.3
Granite bedrock ·········
Boulders ·········
Sand beaches ·········
Sand - thin mud limit ·····
Thin - thick mud limit ····
Shoals ·········
Ledges ·········
Scale
0
800
yards
Contour interval ······· 100'
Depth contour interval ·· 10'
Base U.S.G.S. Topo. Quad ·· x5
John R. Mills May 1949



LEGEND

Spot depths ··· feet ·····	x 26
Station numbers ·········	W.3–E.3
Granite bedrock ·········	
Boulders ·········	
Sand beaches ········	
Sand – thin mud limit ·····	
Thin – thick mud limit ····	
Shoals ············	
Ledges ············	

Scale

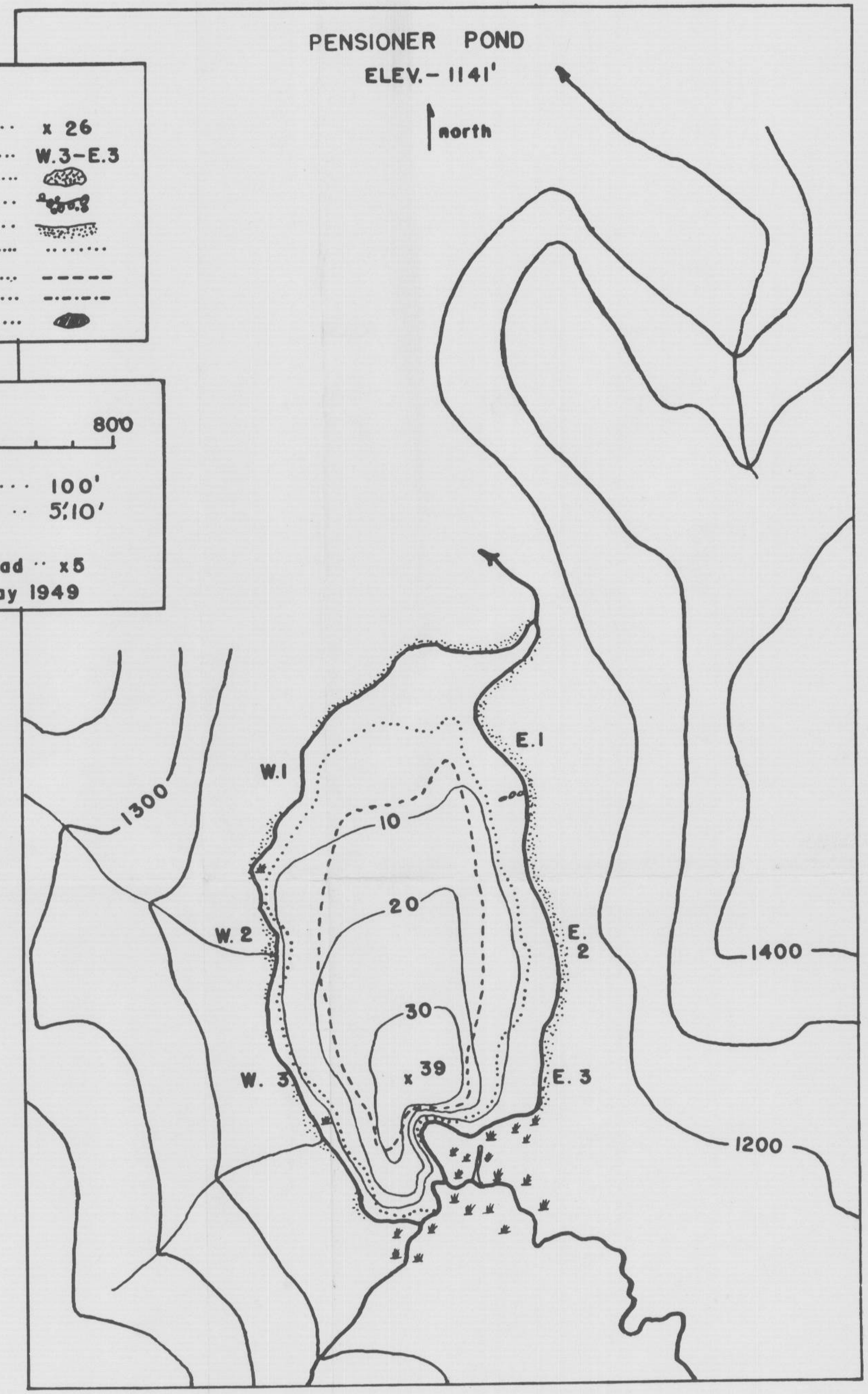
0 — 800 yards

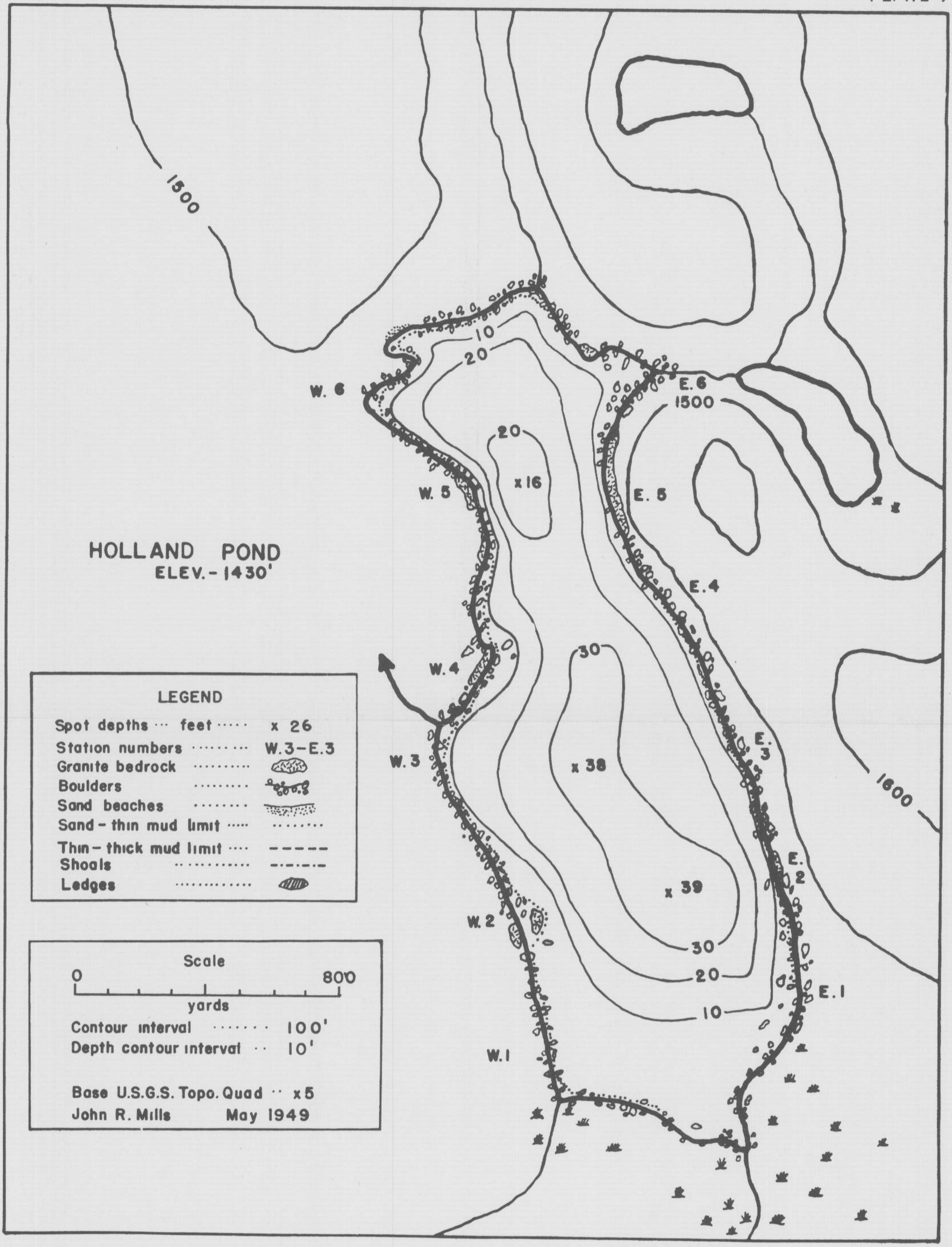
Contour interval ······· 100'

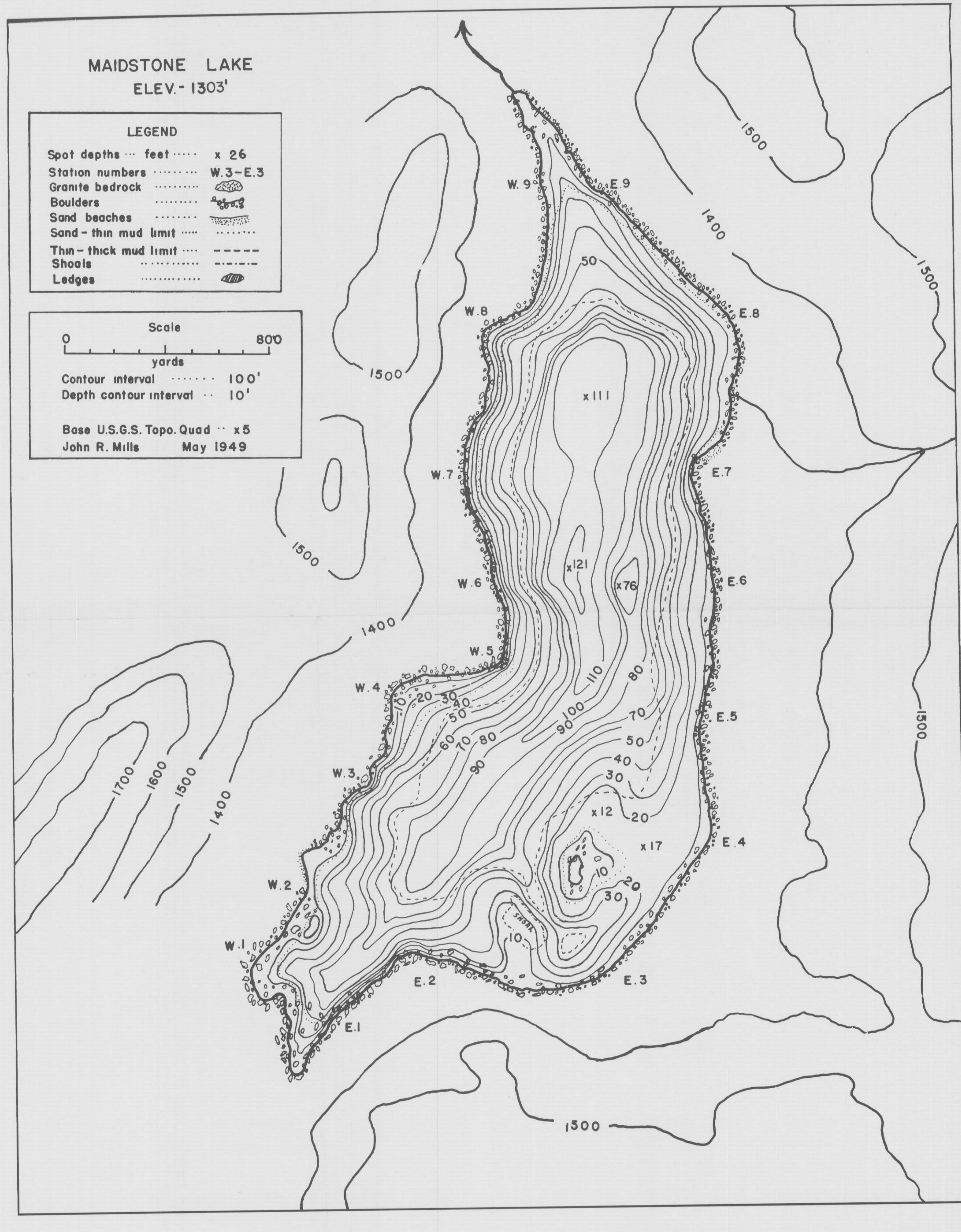
Depth contour interval ·· 5',10'

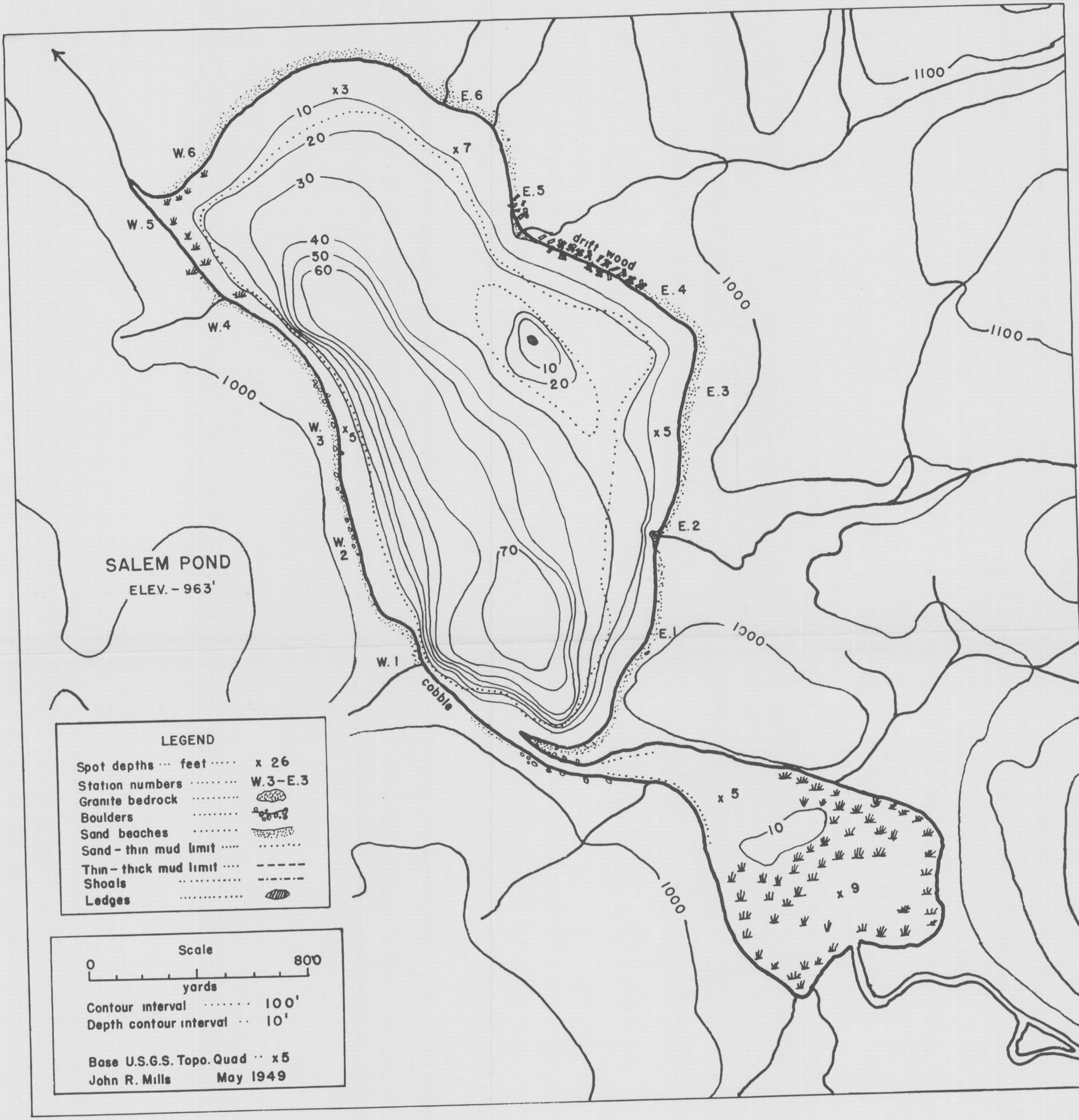
Base U.S.G.S. Topo. Quad ·· x5

John R. Mills May 1949




HOLLAND POND
ELEV. - 1430'
1500
1500
1600
10
20
20
30
30
20
10
x 16
x 38
x 39
W. 6
W. 5
W. 4
W. 3
W. 2
W. 1
E. 6
E. 5
E. 4
E. 3
E. 2
E. 1
LEGEND
Spot depths ··· feet ····· x 26
Station numbers ········· W. 3 – E. 3
Granite bedrock
Boulders
Sand beaches
Sand - thin mud limit
Thin - thick mud limit
Shoals
Ledges
Scale
0
800
yards
Contour interval ······· 100'
Depth contour interval ·· 10'
Base U.S.G.S. Topo. Quad ·· x 5
John R. Mills May 1949


MAIDSTONE LAKE
ELEV. - 1303'
LEGEND
Spot depths ··· feet ····· x 26
Station numbers ········ W.3 - E.3
Granite bedrock
Boulders
Sand beaches
Sand - thin mud limit
Thin - thick mud limit
Shoals
Ledges
Scale
0
800
yards
Contour interval ······· 100'
Depth contour interval ·· 10'
Base U.S.G.S. Topo. Quad ·· x5
John R. Mills May 1949
W. 9
E. 9
W. 8
E. 8
W. 7
E. 7
W. 6
E. 6
W. 5
W. 4
E. 5
W. 3
E. 4
W. 2
W. 1
E. 2
E. 3
E. 1
x 111
x 121
x 76
x 12
x 17
SHOAL
1500
1400
1700
1600


SALEM POND
ELEV. - 963'
LEGEND
Spot depths ··· feet ······ x 26
Station numbers ········· W.3-E.3
Granite bedrock
Boulders
Sand beaches
Sand - thin mud limit
Thin - thick mud limit
Shoals
Ledges
Scale
0
800
yards
Contour interval ······· 100'
Depth contour interval ·· 10'
Base U.S.G.S. Topo. Quad ·· x5
John R. Mills May 1949
W.1
W.2
W.3
W.4
W.5
W.6
E.1
E.2
E.3
E.4
E.5
E.6
drift wood
cobble
1000
1100
10
20
30
40
50
60
70
x3
x7
x5
x9

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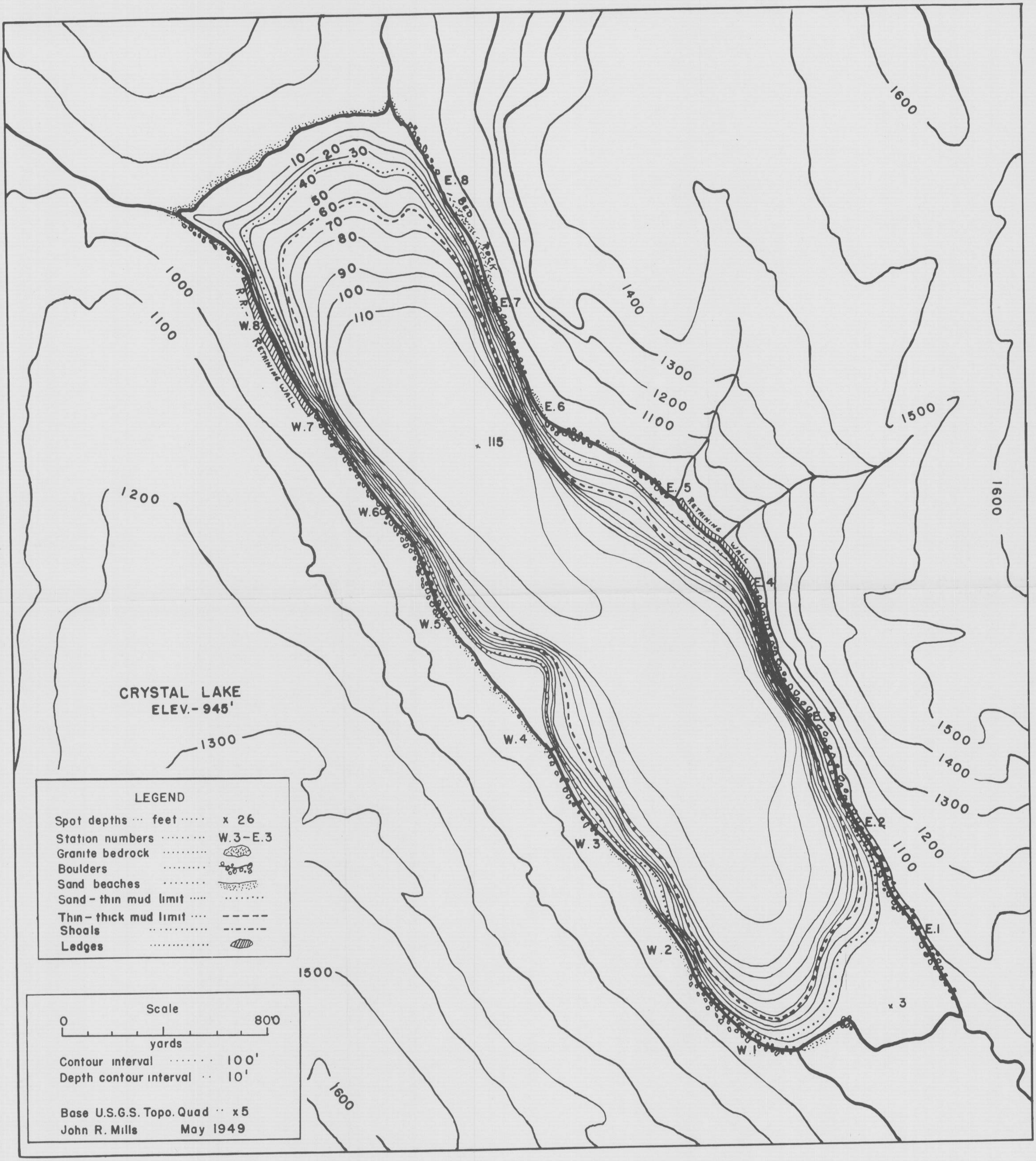
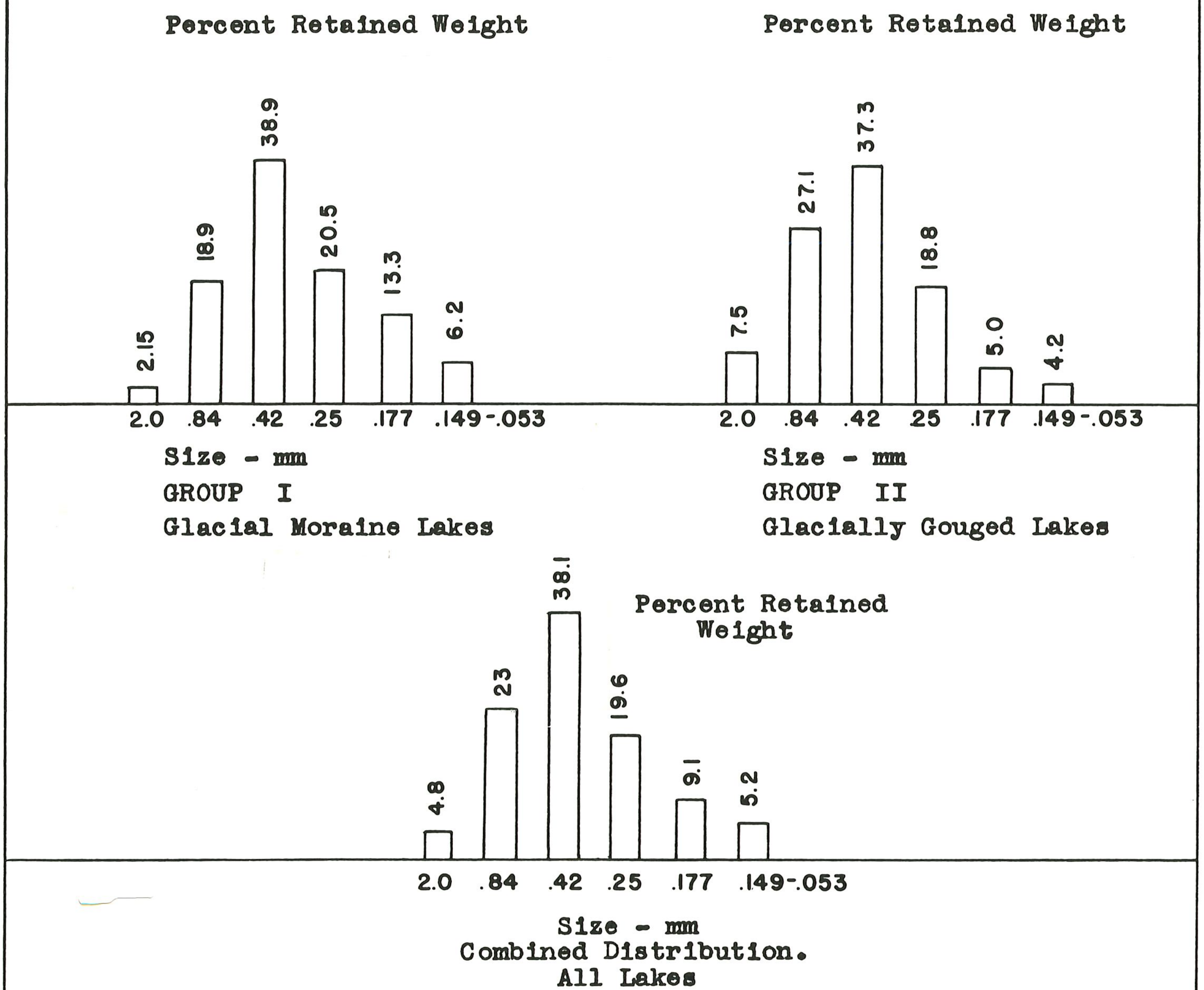

CRYSTAL LAKE
ELEV.- 945'
LEGEND
Spot depths ·· feet ····· x 26
Station numbers ········ W.3-E.3
Granite bedrock
Boulders
Sand beaches
Sand - thin mud limit
Thin - thick mud limit
Shoals
Ledges
Scale
0
800
yards
Contour interval ······ 100'
Depth contour interval ·· 10'
Base U.S.G.S. Topo. Quad ·· x5
John R. Mills May 1949
10
20
30
40
50
60
70
80
90
100
110
x 115
x 3
E.1
E.2
E.3
E.4
E.5
E.6
E.7
E.8
W.1
W.2
W.3
W.4
W.5
W.6
W.7
W.8
R.R.
RETAINING WALL
RETAINING WALL
BED ROCK
1000
1100
1200
1300
1400
1500
1600

HISTOGRAMS OF SAND SAMPLES

BASED UPON SIFTED & WEIGHED SAMPLES



U.S. STANDARD SIEVES
Numbers 10, 20, 40, 60, 80, 100, 200, 270
Diameter of Openings in Millimeters

FIG. 1