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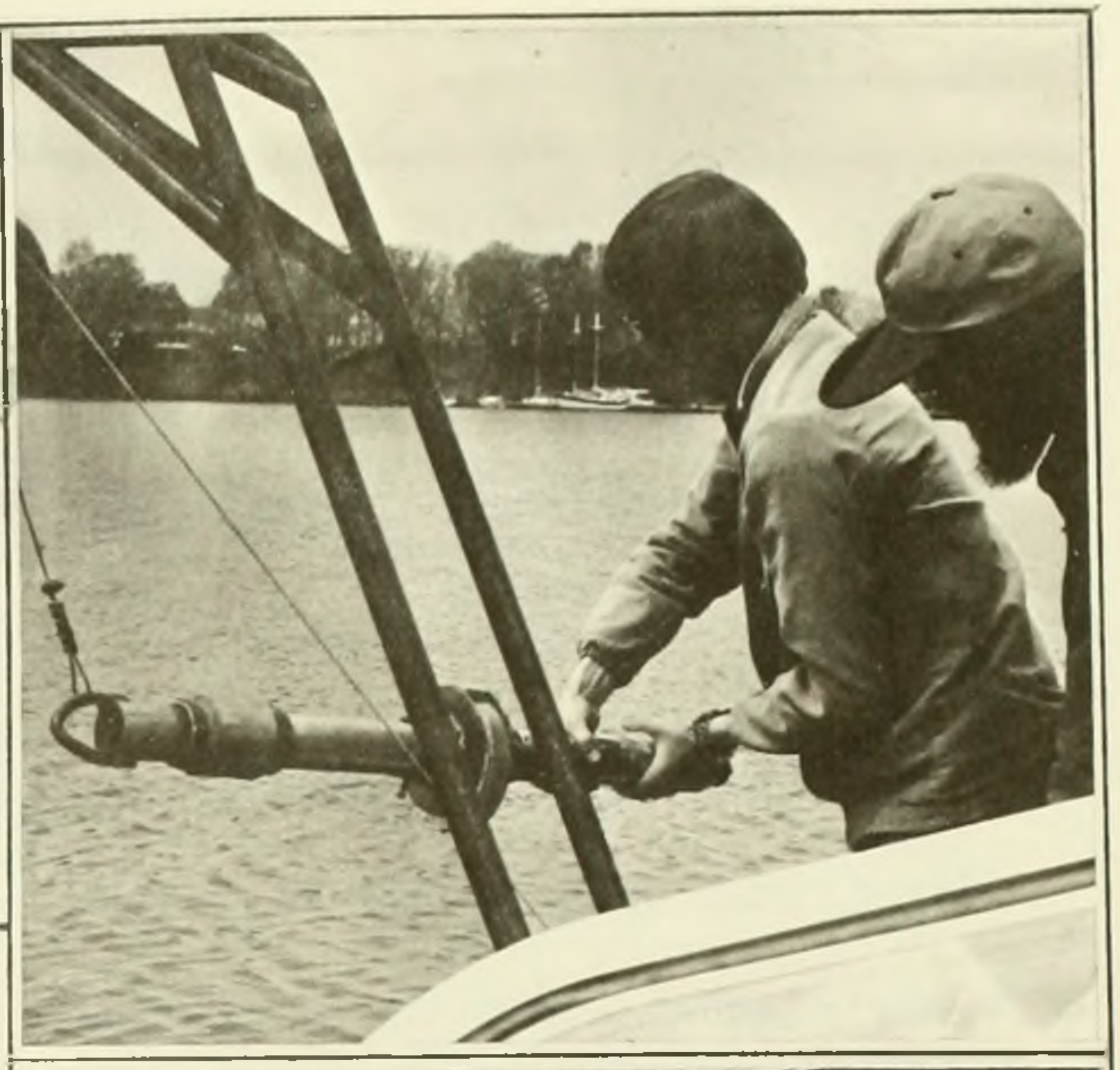
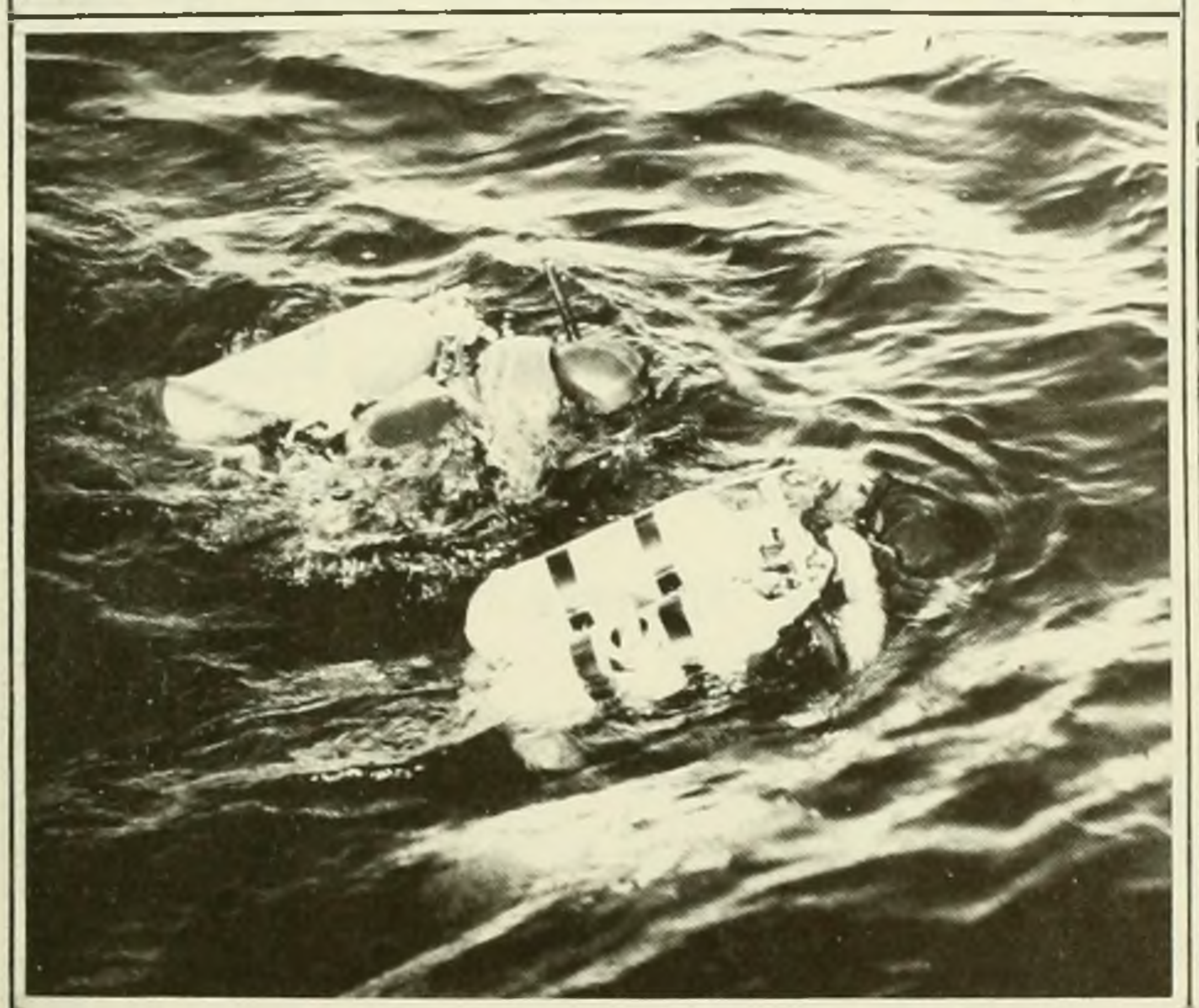
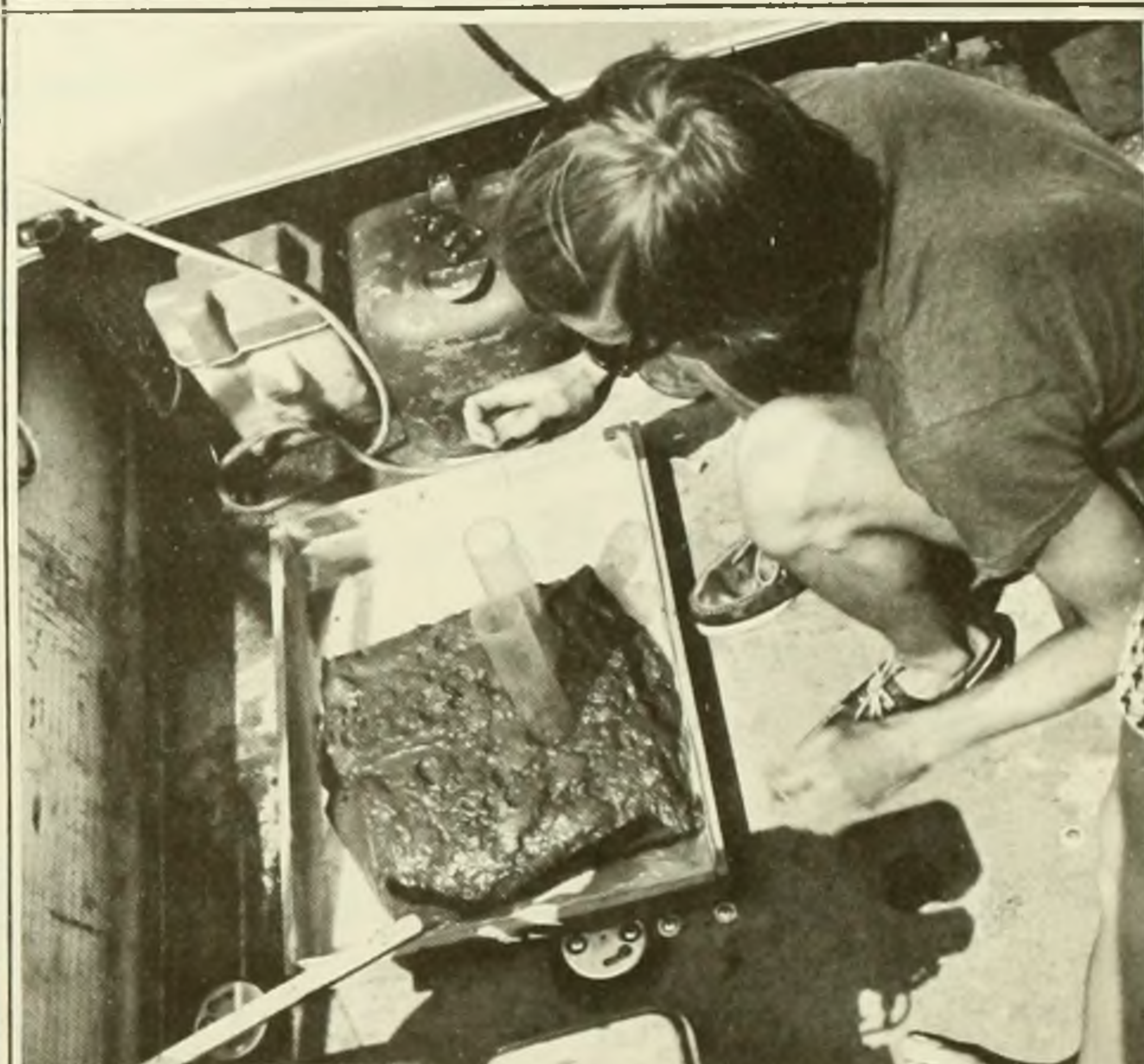
The Sludge Bed at Fort Ticonderoga, New York

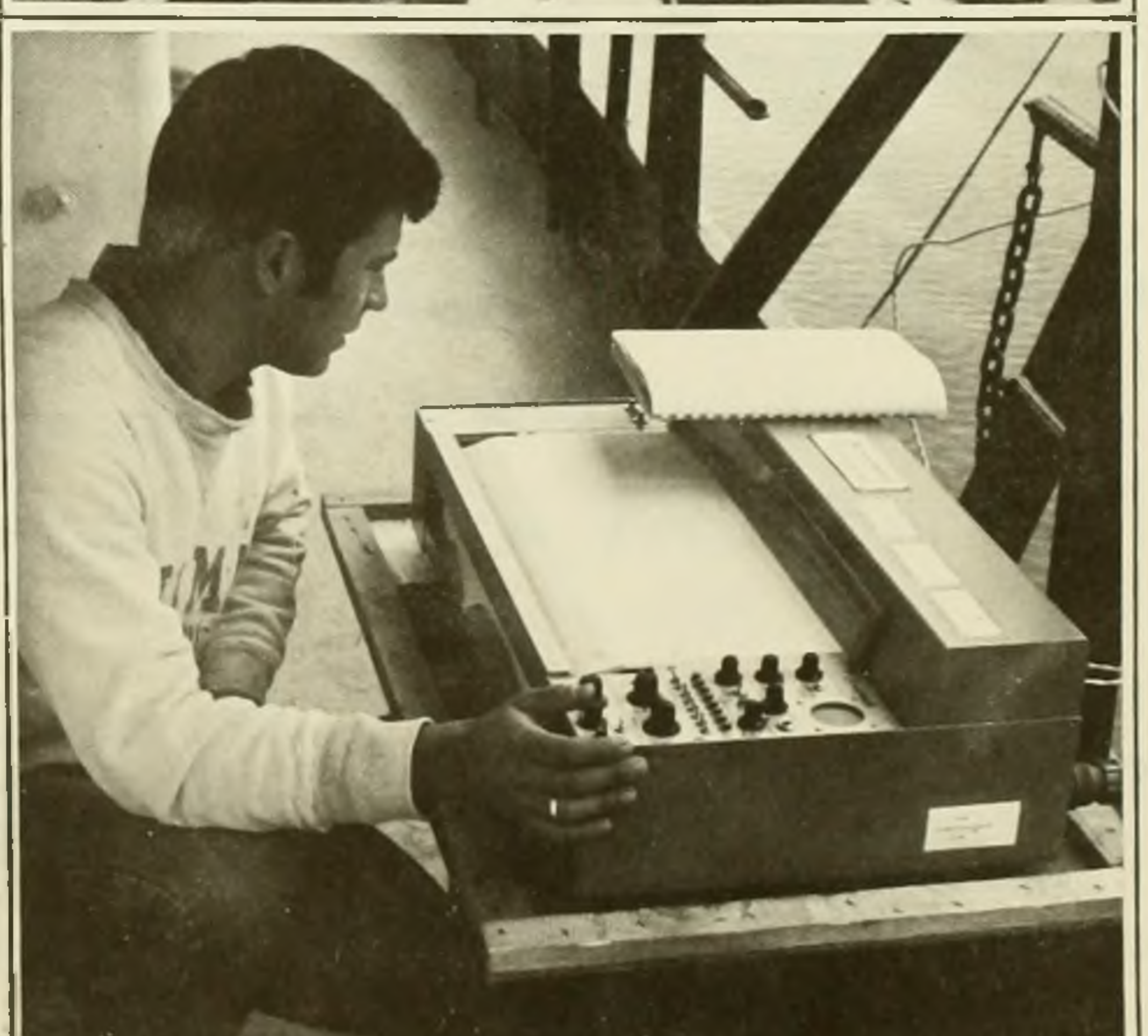
Folger, D.W.



lake studies







Lake Studies Cover page: Various aspects of Lake Studies program, UVM Department of Geology. Photo at lower left by Robert Howe, UVM Geology Department. All others by Arthur Huse.

Trip LS-1

THE SLUDGE BED AT FORT TICONDEROGA, NEW YORK

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Introduction

While the legal battle has raged between Vermont and New York over the future of the sludge bed located at the mouth of Ticonderoga Creek, southern Lake Champlain, several comprehensive studies have been underway to determine the size, shape, and composition of the organic-rich deposit and its effect on lake geology, chemistry, and biology. Those involved represent Federal, State, and private organizations. Among them are the Federal Water Quality Administration, the U.S. Army Corps of Engineers, the University of Vermont and Middlebury College (FWPCA, 1968; FWQA, 1970, Folger, 1972).

Participants in this field trip will study the area (Fig. 1) from Middlebury College's research craft with such equipment as an echo sounder, surface drifters, Van Dorn bottles, secchi disc, dissolved oxygen kit, and grab samplers. They will thus gain a first hand look at the bathymetry, current regime, suspended matter and oxygen distribution and will be able to assess the effect of the pollutants on some physical properties of the sediments.

Creek Inflow and Sediment Characteristics

Ticonderoga Creek flows eastward from Lake George through the village of Ticonderoga to Lake Champlain over a distance of 5 km and vertical drop of 74 meters. Creek discharge at Lake

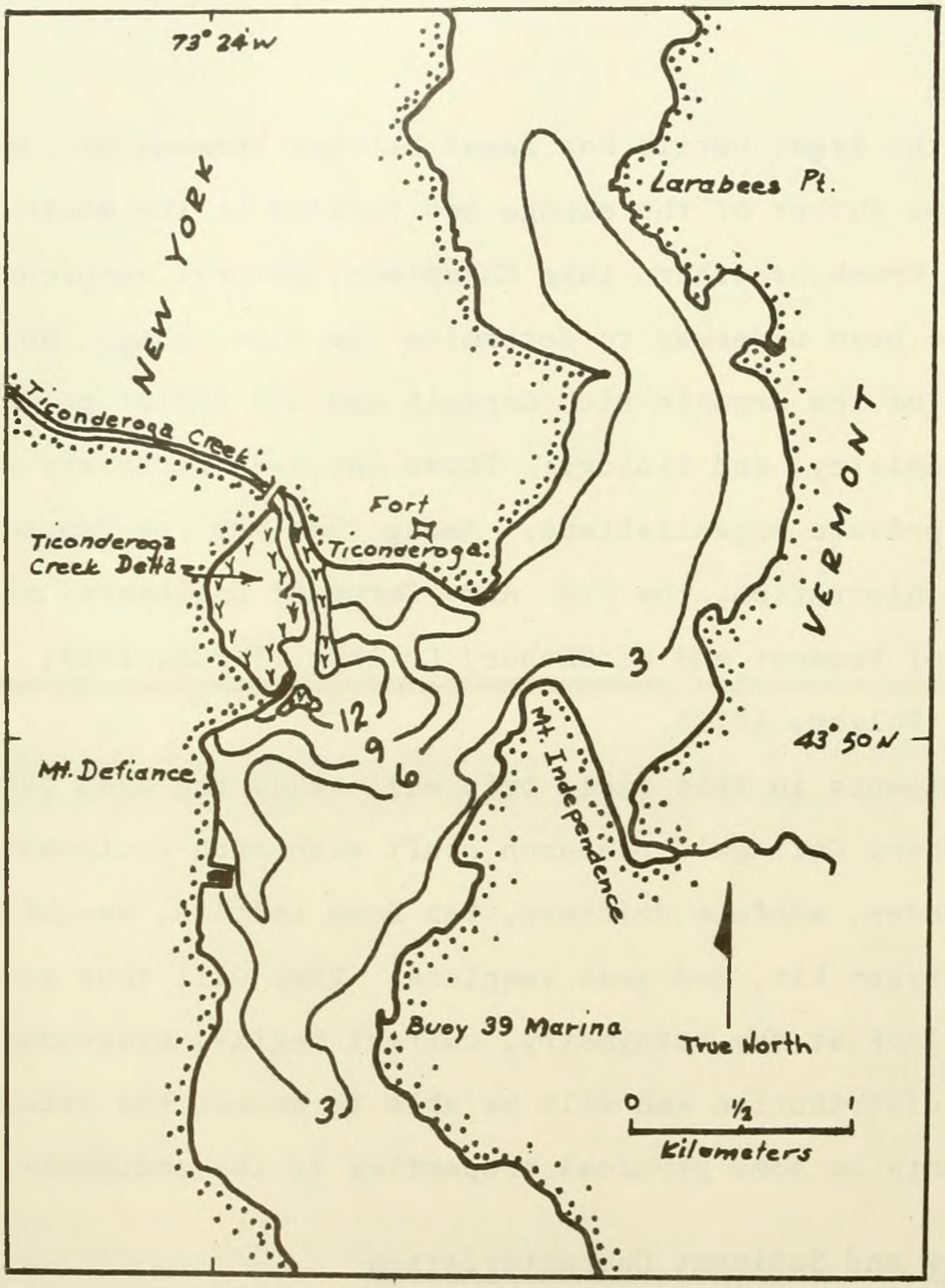

Figure 1. Contours showing organic carbon concentration (% dry weight) in bottom sediments of Lake Champlain.

George averaged 9 m^3/sec over a 17 year period with a maximum daily flow of 37 m^3/sec and minimum of about 0.2 m^3/sec (Wells, 1960). Because of five dams on the creek and because the creek and its main tributary, Trout Brook, both flow mostly over resistant metamorphic terrane where gradients are steepest the natural suspended load transported to Lake Champlain is probably low except during periods of high runoff. Below the dams, however, the creek carried abundant waste to the lake from the International Paper Company plant while it was in operation. Much of the delta built into the lake therefore consists of material derived from the paper plant and other industrial or municipal sources (FWQA, 1970).

The lake bottom drops off from the shallow delta front to the axis of the main lake channel where maximum depths are between 6 and 7 meters. The dark gray to black silty, sandy clays that cover the bottom near the creek mouth grade to very fine-grained greenish-gray clay (median diameter < 2 microns) over a distance of several kilometers to the north and south. Acoustic penetration at 50 kHz of several meters in the finest textured clay is sharply reduced in sediments near the creek mouth. This is probably due to the coarser texture of the material but it may be due partly to the abundant gas in the most organic-rich sediments. Chlorite and illite are the dominant constituents of most bottom sediments in the southern part of the lake. Near Ticonderoga Creek, however, kaolinite becomes abundant with pollutants such as wood chips and fibers (Aubrey, 1971).

Pollutant Distribution

Because organic carbon is abundant in the paper plant waste, its distribution can be used to outline the sludge bed. Figure 1 shows contours of the organic carbon in bottom sediments. Highest values (~14%) are concentrated near the creek mouth and decline to the north and south where few values exceed 2%. Some higher values have been measured in sub-bottom sediments (FWQA, 1970). Nitrogen is distributed in a similar pattern but concentrations grade only from about 0.4% to 0.2%. The highest values probably result mostly from raw sewage dumped into Ticonderoga Creek by the village of Ticonderoga (FWQA, 1970). Measurements of titanium, which is used as a whitener in the paper making process, have been made on sub-bottom samples collected on or near the delta. Concentrations range from 14.7% to less than 1% (FWQA, 1970). All three components decline in concentrations with distance from the creek mouth and appear to be good indices of effluent distribution on the bottom.

Flow Regime and Suspended Matter

The distribution of carbon also provides a rough guide to the flow regime of the lake in the area. Highest values, for example, extend farther north than south apparently as a result of the predominant northward flow of the lake. The smaller tongue of high values that extends southward probably is caused by the physiography of the delta which directs some creek flow southward especially on the west side of the lake and by reversals of lake flow when strong winds periodically blow from the north. Measurements of surface currents in the fall of 1971 verified motion in both directions. Four surface drifters released in mid-channel north of Buoy 39 Marina moved northward at velocities between 6 and 12 cm/sec; two others released off the Marina moved southward at velocities between 1 and 5 cm/sec. Flow over the sludge bed is apparently sufficient to prevent oxygen depletion in bottom waters.

The concentration of suspended matter in bottom waters during the fall of 1970 ranged from about 15 to 20 mg/liter. Because higher values ($\sim$25 mg/liter) were observed north of the area shown in Fig. 1, it is doubtful that pollutants from the creek are primarily responsible for the high turbidity. Rather, most suspended matter probably consists of clay minerals stirred up by waves from the broad shallow shelf that surrounds most of the southern part of the lake.

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