Sonar Probing in Narragansett Bay

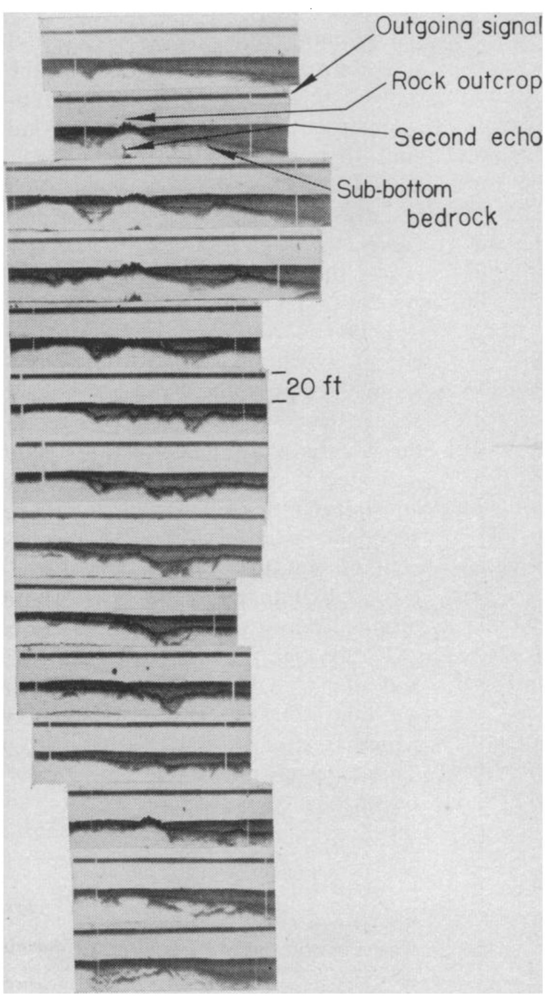
Abstract. *A 12-kilocycle pulsed transducer, with a 0.1 millisecond duration, is used for tracing a sub-bottom rock profile in Narragansett Bay. The short sonar pulse of high energy is produced by a capacitor discharge. Over-the-side installation of the transducer permits the use of any boat or ship for the survey work. Coherent presentation of the data on a wet paper recorder gives an instantaneous visual record. Across a north-south rock formation, a recurring rise and fall of the rock is shown throughout the sedimentary deposit.*

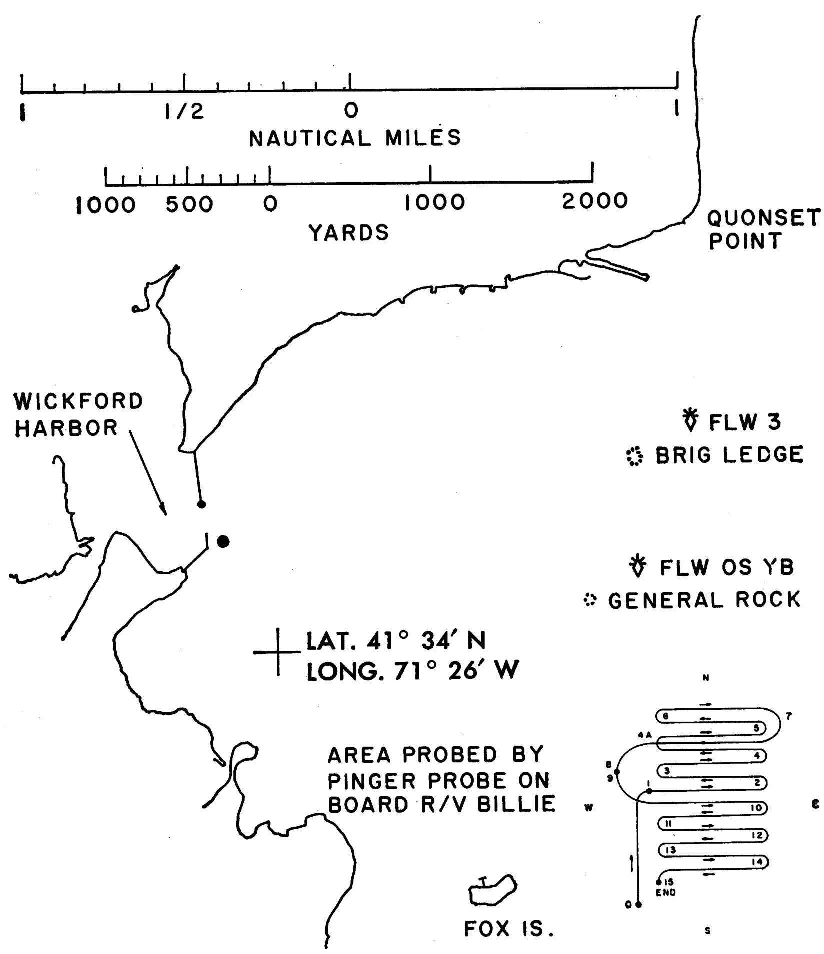
Sonar is commonly used on ships as a device for measuring the water depth and for locating fish, submarines, and other submerged objects (*1*). The specialized sonar described here, called a "pinger," in addition to being able to measure depth, can also probe the sea bottom and reveal archeological objects, shell layers, sediments, and rock ledges. The instrument has already been used to gain information on what is below the surface of the sea bottom (*2*), and we report here some records from a limited area of Narragansett Bay, Rhode Island.

The features that make a sonar useful for penetration are as follows. (i) A very short but intense acoustical signal of about 0.1 msec duration. A depth resolution of about 30 cm is realizable. (ii) A portable transducer usually not mounted on the hull, as with conventional sonar, but suspended over the side of the ship with an indicator to show perpendicularity. The sonar transducer must produce a sonar beam that is perpendicular to the bottom surface; otherwise, most of the sound will not penetrate or return from the sub-bottom layers. Transferring of the equipment to another ship is easily accomplished. (iii) A paper recorder of instantaneous display capability and signal density gradation. Signal recognition by optical correlation is obtained and continuous seismic profiling is realized.

A continuous strip of record, called a seismic profile, is produced when the ship slowly progresses over the area of interest. The signals received by the recorder are placed in sequence on the paper which is transported at a slow rate. It has been found that obscure signals that cannot be detected, for example, on a single-sweep cathode ray oscilloscope, become obvious since they add up at the same place on the line on the recorder for all sweeps, whereas the noise signals create marks at random places.

Test runs with a pinger probe were made in August 1963 in Narragansett Bay. The equipment, including a 500-w portable generator (Kohler), 1800 rev/





Figs. 1–3. Fig. 1 (left). Pinger penetration records made in Narragansett Bay on board *R/V Billie* of the University of Rhode Island. The profiles were recorded in numerical sequence (Fig. 3) and have been arranged in north-south order above. Maximum penetration was 45.7 feet (13.7 m). Fig. 2 (right). Chart showing area "pinged" in Narragansett Bay. Nautical mile is equal to 1853 m; 1000 yards is equal to 900 m. Fig. 3 (insert in Fig. 2). Track of pinger runs made by *R/V Billie* on 21 August 1963.

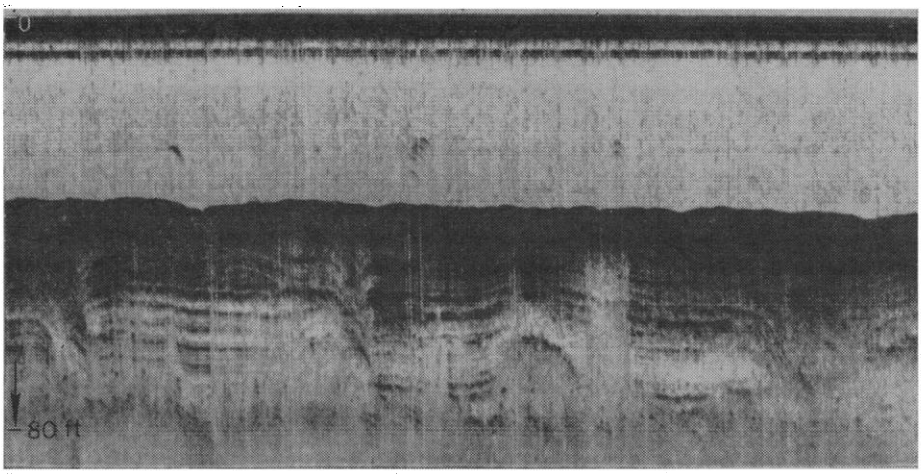


Fig. 4. Pinger record made just south of the Quonset Point Naval Air Station showing nonuniform distribution and peculiar slumping of the layers in the sub-bottom sediment.

min, was carried in the *R/V Billie* from the University of Rhode Island, Narragansett Marine Laboratory. Figure 1 shows tracings of successive east-west runs across an area south of Quonset Point Naval Air Station (Figs. 2 and 3).

The pinger probe is a 12-kc, short-pulse, high peak-power sonar (0.1 msec, 108 db) which has been adapted for bottom penetration in shallow water. It can detect sedimentary layers and objects in the sub-bottom. Its components consist of a sonar transdriver which contains a power supply, storage capacitors, and a two-stage preamplifier, a marking amplifier, a high-resolution recorder (Alden), and a submersible transducer (EG&G type 228 transducer with type 226 transformer). The sonar transducer is supported by the electrical driving cable from the side of the ship. No mounting on the hull is required. The ship is required to operate at a slow speed, about 5 km per hour.

Figure 1 is a north-south sequential compilation of east-west runs, each about 300 meters in length and spaced about 100 meters apart, with the northernmost record on top. The solid black band at the top of each strip is the recorded surface signal. The bottom profile and sub-bottom rock bedding is clearly shown beneath a water depth of about 6 meters. The irregular rocky surface is post-glacial land surface which has been largely covered by marine sediments. The sediment in this area probably is sandy silt (25 to 50 percent sand, 10 to 20 percent clay) (*3*).

Beginning at the top, or north end, a rock layer is shown, first submerged; then outcropping through the bottom sediment (strips 2 to 5); submerging again (strips 6 to 11); outcropping briefly again (strip 12); and finally disappearing beneath the bottom (strips 13 to 14). Some of the strips are printed in reverse, in order to correlate the east-west edges. A "second" bottom echo, due to the sound traversing the bottom to surface path a second time, is visible in several of the strips, for example, in the second, third, and fourth strips measured from the top. Scouring of sediment to a depth of about 0.3 meter from around the outcropping rocks is evident, which indicates that tidal flow or hurricane-induced flow has left its mark.

The horizontal alignment of the several sonar records of Fig. 1 is probably inaccurate. The main outcrop of rock may not be uniform in a north-south direction.

Another area, just south of the Quonset Point Naval Air Station (Fig. 4), shows sediments about 13 meters deep with nonuniform distribution and peculiar slumping of the layers. Similar profiles obtained on other runs across this area ruled out the possibility of electronic vagaries.

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Acetylene Ester from Aster spinosus

Abstract. *A polyacetylene compound,* cis-*lachnophyllum ester, has been isolated from* Aster spinosus *Benth. The presence of this compound in this genus is of taxonomic interest.*

We have isolated an acetylene compound, *cis*-lachnophyllum ester (I) from an Arizona desert plant, *Aster spinosus* Benth.

$$CH_3-CH_2-CH_2-C\equiv C-C\equiv C-CH=CH-COOCH_3$$

cis

I

Although polyacetylenes have been isolated from numerous members of the *Compositae* (*1*), *cis*-lachnophyllum ester (I) has been previously isolated only from the genera *Lachnophyllum* (*2*) and *Erigeron* (*3*). This is the first report of its occurrence in the genus *Aster* and appears to have some chemotaxonomic significance; all acetylene esters previously isolated from *Aster* species have *trans* configurations (*1*).

A recent survey of desert plants (*4*) showed that species with steam-distillable terpene constituents lacked thorns and that thorny species commonly lacked terpenes or other oils. Subsequently we examined a spiny aster (*Aster spinosus* Benth.), which grows beside the San Pedro River in southern Arizona. Unexpectedly, steam distillation of the wet plant material yielded an oil which became a waxy solid at room temperature. An unexpected strong band in the 2200-cm^{-1} region of the infrared spectrum of this compound indicated that it was not a terpene but an unusual acetylene compound. The acetylene, after separation from olefinic contaminants, was characterized as *cis*-lachnophyllum ester (I) by procedures outlined below.

Fresh samples of unground *A. spinosus* (1.0 kg) were steam-distilled, yielding 1.0 g of a yellow, waxy solid which melted at room temperature. Thin-layer chromatography of the solid on silica gel G with chloroform revealed seven compounds. The major constituent (R_F 0.86) crystallized easily in the form of long white needles (mp 32.6° to 32.8°C) from light petroleum. It was positive in permanganate, tetranitromethane, and hydroxamate tests.

The infrared spectrum (CCl_4) contained bands at 2235 and 2140 cm^{-1} (acetylenic groups), 1729 cm^{-1} (conjugated ester), and 1610 cm^{-1} (double