respects from the pollen flora of the interstadial clays and clay tills of the Cape Cod area (*3*).

The exact age of the Leda clay is still unknown. Although there is evidence that glacial ice still existed in the vicinity when the clay was deposited, the fauna is by no means arctic in character. Studies of lake and peat deposits in this region by Deevey (*4*) and me (*5*) indicate that the marine submergence occurred previous to Zone A1 of Deevey's late-glacial pollen chronology.

According to this chronology, widespread tundra conditions prevailed in southeastern Maine and possibly as far south as Connecticut in late glacial time. However, my pollen studies of late glacial clays from eastern New England do not indicate that such conditions existed during the time of deposition. Pollen grains from plants that are common in a tundra or semitundra environment are lacking or are very rare. Furthermore, the total nontree pollen, including spores, is very low compared with the total tree pollen, a condition just opposite to that which occurs in tundra areas. The great number of tree pollens, especially those having a relatively high rate of fall, precludes the possibility of their having been transported by wind any great distance.

The possibility that the pollen grains in the clay from Goose Cove are secondary seems unlikely for several reasons. (i) There are no known interglacial or older deposits in Maine from which the pollen grains could have come. (ii) The unusual abundance of the pollens at Goose Cove and the lack of other plant remains indicate that the plant microfossils have not come from reworked pollen-bearing deposits in the vicinity. (iii) I have examined a large number of other samples of Leda clay and till from eastern Maine for microfossils without success. This absence of pollens elsewhere, together with their localized occurrence at Goose Cove, also indicates that these microfossils are indigenous to the Leda clay of Mount Desert Island.

A comparison of the pollen analysis of the clay from Mount Desert Island with the analyses by Wenner (*6*) of surface samples from the barren and wooded areas of Labrador shows a close similarity to the assemblages found in the forest area of southern Labrador. In this area, the pollens of birch, alder, willow, heath, and sedge—plants commonly found in the tundra areas farther north —are relatively rare, while the pollen grains of conifers are extremely high, as in the Leda clay of Maine.

Evidence that the eastern part of Maine was at least partly forested during the late glacial marine phase is given by Berry (*7*), who identified some fossil plants in the lower portion of shell-bearing Leda clays near Waterville (*8*).

Table 1. Pollen grains and spores found in Leda clay from Goose Cove, Mount Desert Island, Me.

Species	Percentage
Picea (spruce)	51
Pinus (pine)	28
Abies (fir)	7
Ulmus (elm)	1
Quercus (oak)	1
Tsuga (hemlock)	trace
Rosaceae cf. (rose family)	1
Gramineae (grass)	7
Fern spores	2
Spores (undifferentiated)	2

Among the plants identified were the leaves of balsam poplar (*Populus balsamifera*), which was the only plant found that has strictly northern affinities. This tree is now distributed from the forest area of Labrador south to northern New England. The rest of the plants identified are shrubs that have a more southern distribution and are also common in Maine at the present time. On the basis of these plant remains, Berry came to the conclusion that, during the marine submergence, the climate of southeastern Maine was similar to that of today.

Thus, from the evidence of the fossil plants and pollen, it seems probable that extensive forest growth existed in eastern Maine during the marine submergence in late glacial time and that the climate, as deduced from the flora of the clays, was at least as warm as that of southern Labrador today.

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2 February 1956

Two Obscure Oyster Enemies in New England Waters

The American oyster, *Crassostrea virginica* (Gmelin), like many other pelecypod mollusks, is attacked by numerous enemies. Of these, the common starfish, *Asterias forbesi* (Desor), and two species of drills, *Urosalpinx cinerea* (Say) and *Eupleura caudata* (Say), are best known. Certain other enemies, perhaps because they are less striking in appearance, are comparatively small or, because they are not easily observed, are little studied and their activities are virtually unknown. This is true of the two forms which I have been recently observing in New England waters and which may be responsible for several "mysterious" mortalities of oysters, especially the young. One of these enemies is a flatworm and the other is a gastropod.

The worm is the polyclad, *Stylochus ellipticus* (Girard), identified by Libbie H. Hyman of the U.S. National Museum. It is usually found among oysters and old shells, on barnacles, and under rocks. Although the biology and destructiveness of the closely related species, *Stylochus inimicus* (Palombi), the so-called oyster "leech" of southern waters, have been extensively studied by several investigators, including Pearse and Wharton (*1*), very little is known of many aspects of the biology of *S. ellipticus* of New England waters, and the extent of its predation on our oysters has never been systematically observed or accurately estimated.

Our recent studies suggest that *S. ellipticus* plays a rather important role in the destruction of oysters, especially young ones. Laboratory observations have shown that the worms have little difficulty in entering and killing spat, even those measuring more than 2.5 in. in length. In one experiment, when ten worms were placed in the same dish with 30 healthy spat averaging about 1.7 cm in length, the worms killed 21 spat in less than a month. Not a single spat died in the control tray during that period. On at least two occasions, we saw the worms entering slightly open oysters. A day or two later, these oysters were gaping and soon died. A single worm was found in one oyster, and in the second, three worms were feeding on the oyster meat.

Since *S. ellipticus* has been found in comparatively large numbers in many areas where oysters grow, it, no doubt, can present an important problem. This contention is supported by Woelke's (*2*) finding that a closely related form, *Pseudostylochus* sp., causes extremely heavy mortality among three species of oysters grown on our Pacific Coast. Obviously, to gain the necessary information on the destructiveness of *S. ellipticus* and to devise methods for its control, more extensive studies of its life-history and ecological requirements are imperative.

The second enemy is a small gastropod, which was identified by Fritz Haas of the Chicago Natural History Museum as *Menestho* (*Menestho*) *bisuturalis* (Say). By some experts this gastropod is still placed within the genus *Odostomia*. It is a small, whitish snail that seldom reaches the size of 5.0 mm and is often found in shallow water. It belongs to the family Pyramidellidae. Fretter and Graham (*3*), who studied the snail's feeding apparatus in detail and also the mode of life of this group, report: "Pyramidellids are ectoparasites. Each species feeds on a particular species of host, usually a tubicolous polychaete or a lamellibranch mollusc, obtaining attachment to the body by means of the oral sucker, piercing the body wall with the buccal stylet and sucking blood, and perhaps tissue debris, by means of the buccal pump." These authors also gave a list of the hosts that have been found to be attacked by the members of the Pyramidellidae family. More recently, Cole and Hancock (*4*) added to this list *Odostomia eulimoides* (Hanley) and *Chrysallida obtusa* (Brown), which they found caused serious damage to the European oyster, *Ostrea edulis* L. Another pyramidellid was found by Medcof (*5*) to be attached to the siphons of *Mya arenaria* L. Medcof, however, thought that because it had no radula, it was commensal and not a predator.

Recently, I have been observing under laboratory conditions the behavior of *M. bisuturalis* in relation to young American oysters and found that it resembles the behavior described by Fretter and Graham for other Pyramidellidae. The typical feeding position of this snail is along the edges of the oyster shell, to which it attaches itself by the oral sucker. We have often seen groups of these snails occupying such a position on a single oyster. When the shells are open the snails protrude their proboscis to reach the soft parts of the oyster, usually the edge of the mantle. At first the oyster reacts to this stimulus by closing its shells but, apparently, it soon becomes accustomed to it and remains open, even if several *M. bisuturalis* are touching its mantle with their proboscis. In this respect the behavior of the oyster resembles, to a large extent, the reaction of other invertebrates attacked by related species of pyramidellids (*3*).

I found *M. bisuturalis* in large numbers on young oysters, especially those that came from shallow water areas. Although these snails may not be very successful in killing the oysters after the latter reach the size of about 1.0 cm, they, no doubt, interfere with the oysters' normal development and growth. This is often shown by the characteristically deformed shells of the young oysters that came from areas heavily infested with *M. bisuturalis*. The shells, instead of being flat, which is normal for shells of young oysters that are not too crowded, are deeply cupped and may have thickened edges. This abnormality is apparently due to injuries caused, by the activities of *M. bisuturalis,* to the edges of the oyster mantle, the organ that secretes the shell.

As in the case of *S. ellipticus,* it is apparent that we need more information on the feeding habits and general ecological requirements of *M. bisuturalis* before estimating its destructiveness and devising methods for its control.

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10 February 1956

Collection of Atomic Bomb Debris from the Atmosphere by Impaction on Screens

Some of the theoretical factors (*1*) which determine the efficiency of collection of aerosol particles on fibers in a moving air stream are inertia and interception, electrostatic attraction, gravity settling, Brownian diffusion, and thermal forces.

Radioactive particles having a wide range of sizes are produced in an atomic explosion and carried to high altitudes in the fireball. Gravity operates to modify the original particle-size distribution, so that, after a few days, particles in the micron range predominate at ground level. For particles of this size, electric attraction and inertial effects are the most important factors in the deposition process.

Preliminary work with charged wires showed that for fission-product activity, the inertial effect was predominant. The efficiency of collection depends on the extent to which particles aproaching a wire or fiber will strike it and become attached instead of following the streamlines of air flow. Theoretical efficiencies of at least a few percent are predicted for the wire diameters, particle sizes, and air velocities of concern in our experiments (*1*).

During the atomic tests held in Nevada during the fall of 1951 and the spring of 1955, metal screens of various mesh sizes were exposed at Washington, D.C., on a vane arrangement as shown in Fig. 1. The collected radioactivity was removed from the screen by repeated washing with acetone and nitric acid. The wash liquid was evaporated to dryness, and the residue was counted by standard beta-counting techniques. Chemical separation of individual isotopes followed by decay measurements identified the material as recently produced fission products.

Table 1 compares the activity (beta counts per minute corrected for geometry) of weekly collections made at Washington, D.C., during early 1955 with (i) an 80-mesh stainless steel screen, (ii) an efficient filter apparatus (capacity 30 ft^3/min) and (iii) the standard gummed-paper fallout technique (*2*). The total activity collected by the screen in 1 week was roughly comparable to that of a filter collection of approximately 3×10^5 ft^3 of air and, in some cases, was as much as 100 times that deposited on an equal horizontal area by fallout. As determined from the estimated air flow and the amount of activity collected, the screen is about 1-percent efficient in the absence of rain. Since a strong dependence of fallout on rain has been observed, and since there are indications that precipitation will wash activity from the screen, figures for the total precipitation have been included in Table 1.

Comparative measurements of 1-week collections were made, using electrically grounded screens of 40, 60, 80, and 200 mesh. During the period of observation, the amount of activity collected did not vary in a regular way with mesh size. It is possible that the increase in collecting area obtained with the smaller mesh sizes was compensated by the reduced air flow. In a single comparison between grounded and well-insulated screens, the amount of radioactivity collected was not affected appreciably, although the weight of solid matter in the residue was nearly doubled in the case of the insulated screen.

Ordinary cheesecloth (*3*) (about 40 mesh) can be used in place of metal screens and seems to lose less activity during rain. It has the advantage that it may be ignited and the ash counted directly in the same manner as the gummed papers. Flags made of cheesecloth also collect fission-product activity, but with only about one-tenth of the efficiency of the vane-mounted cloth.

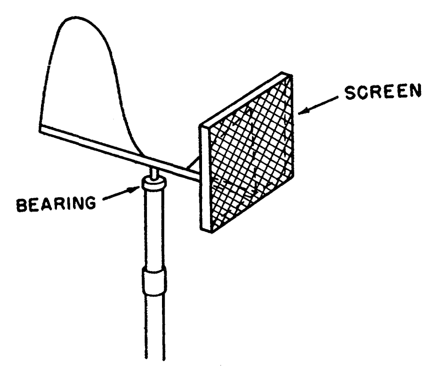

Fig. 1. Rotating vane for holding collecting screens.