Some Devices for the Manipulation of Marine Plankton Collections on Board Ship.

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IN the course of an oceanographical investigation off the west coast of Canada during 1934, it was found necessary to expedite the collection of net plankton and the subsequent filtration of the samples. The apparatus and methods developed in this connection may be of interest to those investigators who have found that the time factor is a very important consideration.

Collection of Plankton with Closing Nets.

Previously, plankton samples in vertical series had been taken with a single closing net which was successively operated through different depth intervals. This procedure was too time-consuming and did not provide simultaneous samples.

In order to overcome these difficulties, a number of plankton nets, similar in design to that illustrated in Figure 1, were used in series.

The skeleton of the apparatus is a rod of wood or an iron pipe (a). The upper end is made fast to a suitable clamp (b), which is fitted with a releasing device and the lower end is fitted with an ordinary snap hook (c) on a swivel joint. The clamp is used to fasten the rod to the sounding wire and the hook ensures its vertical position at all times. On the side of the rod opposite the wire, two other snap hooks (d, d) are rigidly fastened, the one at the bottom end and the other at a position opposite the centre ring of the net.

The plankton net is rigged in the usual manner with the bridle at the top so adjusted that the upper truncated cone is held in position when the bridle is fastened to the release clamp. Small rings, fastened to the centre and the lower end of the net, serve to attach the net to the rod by means of snap hooks.

The release clamp (Figure 2) is made of cast bronze and of the illustrated dimensions. For convenience in attaching to the sounding line, the back is hinged on one side and held on the other by hinged

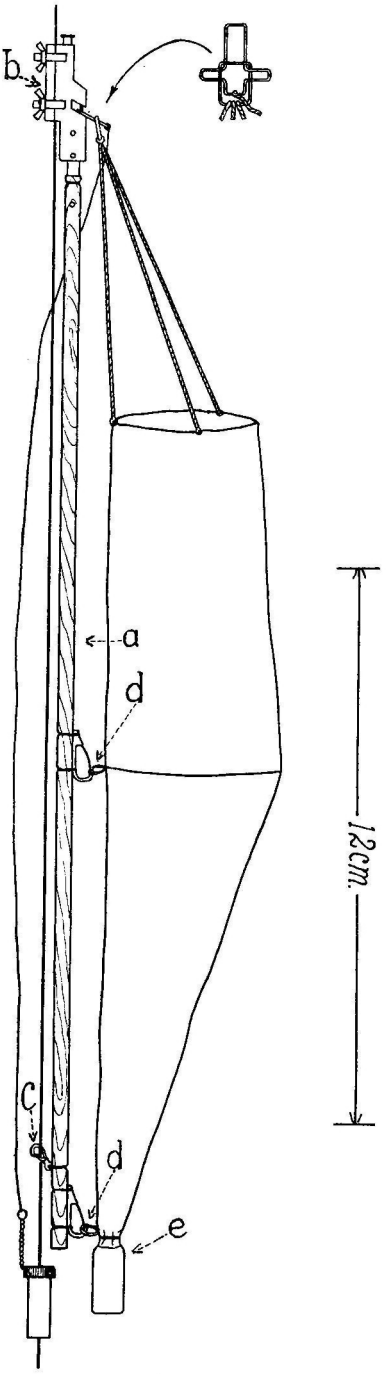
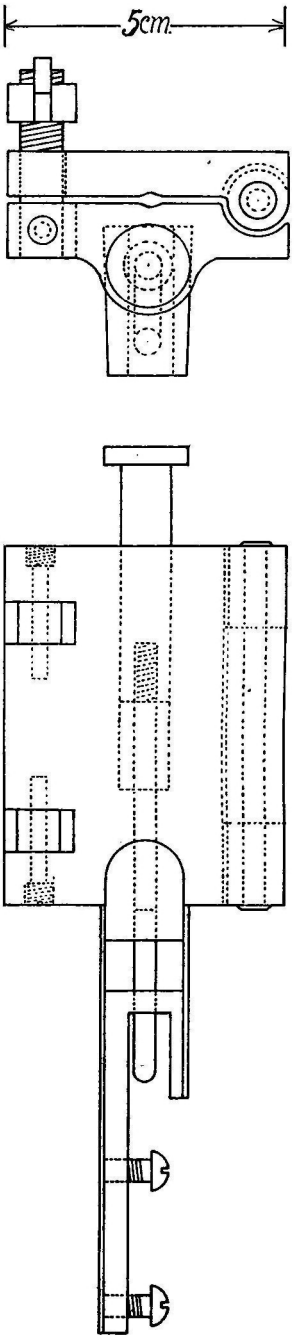


Fig. 1.



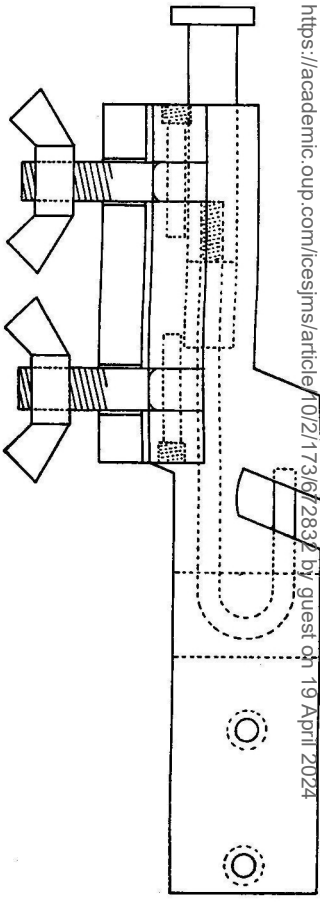


Fig. 2.

bolts which have a loose cut thread so that the wing nuts may be tightened by hand. The top of the plunger is mushroomed to prevent the possibility of the messenger slipping between it and the wire. A lug is used to attach the top end of the rod. Any suitable type of release clamp may be used, but the one shown has proved very satisfactory under the most trying conditions at sea.

If a column of water (e. g., 150 metres depth) is to be examined in three equal sections, the requisite number of nets (3) are attached to rods and placed in readiness on the deck of the vessel. At the proper time, the rods are attached to the wire by the snap hook at the bottom and the release clamp at the top, and placed in series at the predetermined intervals (50 metres). Messengers are attached to each, except the bottom net, as shown in Figure 1. (A convenient method of attaching the messengers is shown in the inset, Figure 1). The nets are then lowered to the desired depths, hauled upward through the predetermined interval (50 metres), a messenger released from the deck and the nets successively tripped. The whole outfit is then hauled on deck and taken from the line, the nets removed from the poles and hung in racks until the investigator can attend to the collection. In this manner the whole column of water is sampled in equal sections in one haul.

If it is desired to vary the interval through which the nets are hauled, a group of three or four are placed a long distance apart for the deep haul and when they are returned to the deck a fresh set of nets with their rods is instantly fitted to the cable and a second group of samples taken at smaller intervals from the shallower part of the column. In this manner it is found possible to divide a depth of 200 metres into nine intervals which may be sampled in three hauls: first haul, three nets 40 metres apart; second haul, three nets 20 metres apart; third haul, four nets 5 metres apart.

It was found convenient to use glass bottles in place of the usual silk-panelled buckets on the bottom of the nets. These were held in position by means of a ring clamp (Figure 1, e) and, when the nets were returned to the deck after a haul, the bottles were detached and removed to the laboratory for the further manipulation.

Apart from the increased rapidity of this method, there are several advantages to be gained, such as ease of handling and efficiency of performance. The nets are held open at all times by the rods and may be fastened to the line as easily as any deep-sea water-sampling bottle. Furthermore, the rod protects the net from damage by contact, and as a small weight may be used for a sinker (since the nets are held open by the rods) the strain on the fabric due to the plunging of the vessel in heavy seas may be minimized.

Filtration of Phytoplankton Samples.

It is customary to collect the phytoplankton samples in a one-litre Ekman deep-sea water bottle, at the same depth from which the sample for water analysis is drawn. In a depth of 200 metres there

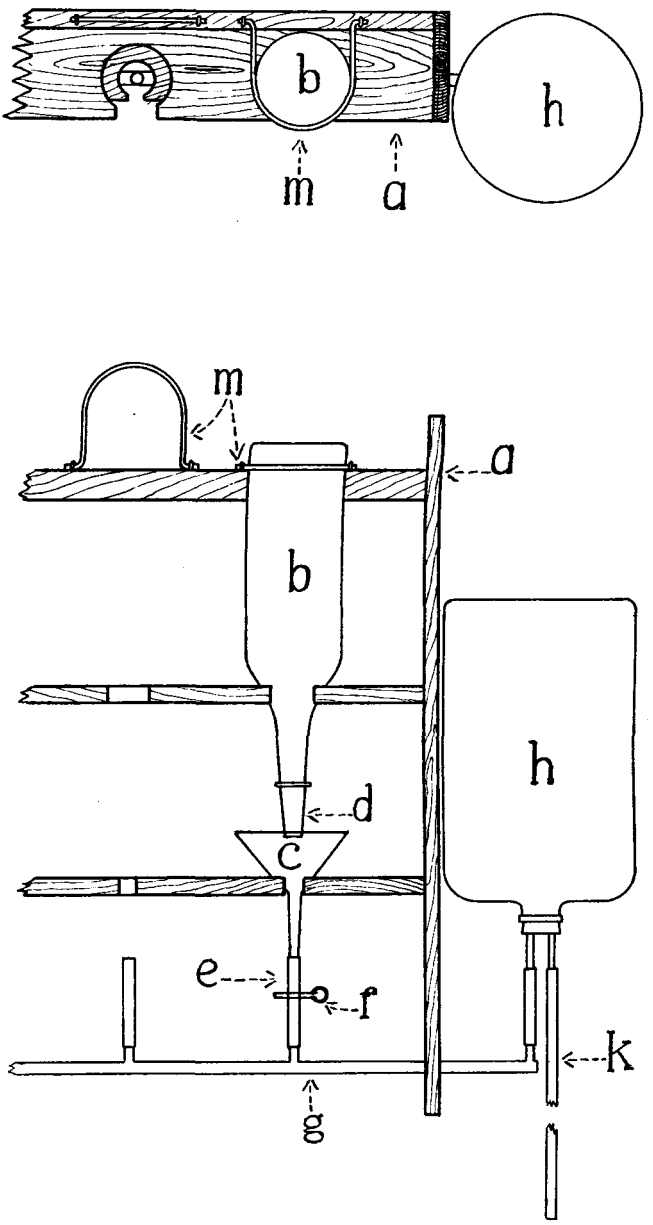


Fig. 3.

are eleven samples, each of which is passed through a hardened filter paper and the collected plankton counted. The tedium of filtering is obviated by the use of the illustrated apparatus (Figure 3).

A rack (a) is constructed to hold a number of bottles (b) containing the samples to be filtered and a similar number of funnels (7 cm. diameter) (c) in the position shown. A nipple (d) made from a short piece of rubber tubing of large diameter (15 mm.) is fitted over the neck of each bottle and adjusted so that, when the bottles and the funnels are in position, the end of the tubing is about one-half centimetre below the rim of the funnel. The stem of each funnel is inserted into a short length of rubber tubing (e) to which a stopcock (f) is fitted, and which leads into a (copper) tube (g) which is connected to the (four-litre) bottle (h) which is filled with water and served to maintain the suction. From this bottle a long piece of rubber tubing (k) leads to the waste drain or a bucket placed about one and a half metres below the level of the bottle.

The filters are fastened by revolving the edge of the funnel containing the folded paper in a shallow pan of melted, hard or laboratory wax, and the folded edge inside the funnel should be sealed with melted wax from a medicine dropper so that no plankton may get under it. If the paper is folded so that it touches the funnel only around the upper edge, the maximum filtration surface is exposed and the process is very rapid. If they are perfectly sealed into the funnels about one and a half metres of suction is sufficient. The bottom end of the suction tube should be placed under water to prevent air backing up the tube.

The sample to be filtered is placed in the bottle (b) and by pinching the rubber nipple (d), it may be overturned and placed in the rack (a) without spilling and then locked in position by means of the hinged ring (m). It is customary to transfer the sample directly from the Ekman water bottle to this bottle, which is numbered to correspond with the depth observed, and as each bottle has its own position in the rack there is no need for further adjustment of the nipples once the bottles have been put into service. By removing the pinchcock from the rubber tube below the funnel, the suction is started and filtration is allowed to proceed to completion when the suction is stopped by replacing the pinchcock. Very little attention is required on the part of the investigator, as notice that filtration is completed is sounded by the system "sucking air" through the empty filter. The plankton may then be washed off the filter paper by a stream of distilled water or filtered sea water from a wash bottle without removing the paper from the filter[1]).

It was found advisable to start the samples from the surface zone first as they usually take much longer to filter on account of the relatively large number of plankton organisms.

[1]) N. M. Carter and J. P. Tully. "Oceanographical Investigations of the Pacific Coast of Canada, Strait of Georgia: I. Methods." Journ. Biol. Bd. Can. In press.

This whole apparatus was securely fastened to the wall of the ship's laboratory where it functioned satisfactorily under all conditions found at sea.

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Summary.

An apparatus is described by which any number of equal sections of a vertical column of water may be sampled simultaneously for net plankton. A plankton net for each section to be examined is attached to a rod of wood or an iron pipe, which in turn is fastened to the sounding wire by means of a release clamp and a snap hook. When these nets are set at equal intervals and the whole arrangement hauled through this interval, and the nets tripped, the entire column is sampled simultaneously and the time of operation reduced to a minimum.

A compact, automatic apparatus which enables the volume of phytoplankton samples to be reduced by filtration through paper, is described. A bottle containing the plankton sample is inverted into a funnel and suction is applied by gravity flow. The whole apparatus is fitted into a wooden frame and is peculiarly adapted for use on board ship.