absorbed and may afterwards be communicated to other surfaces.

The importance of this discovery can scarcely be overrated, and there is no doubt but that it will work an era in the matter of carbon printing. We need secure but one single photograph printed in the sun in order to obtain a large number of copies, all of which shall be as delicate and vigorous as if they had been printed by sunlight. A sheet of gelatine sensitised with bichromate of potash is put under a negative and printed ; it is withdrawn from the printing frame and immersed in a weak solution of bichromate of potash which swells up those portions of the surface that have not been attacked by light, and thus produces a picture in relief. The sheet of gelatine is then put into a press and impressions from it taken on sensitive carbon tissue, the block being moistened from time to time with bichromate solution. The copies thus produced upon the tissue are not fully printed and cannot be developed at once; they are simply incipient, or nascent, pictures, it must be mentioned, and they require preservation in the dark for some hours to allow the action of the light to continue, exactly in the same way as if the carbon tissue had been exposed to sun-light for a few minutes. When the prints have been kept sufficiently they are developed in warm water, and fine vigorous copies are the result. Naturally enough if the tissue is kept too long after, the mordant action of the light continues rendering the film insoluble, and then the development of the image in warm water obviously becomes impossible.

Another application of the same principle has been made by M. Marion, in which carbon printing is assimilated to silver printing, to such a degree, that those accustomed to the ordinary method of printing photographs on albumenised paper, would find no difficulty in adopting it. H. BADEN PRITCHARD

GN THE METHOD OF COLLECTING AND PRESERVING ENTOMOSTRACA AND OTHER MICROZOA

CONSIDERING the varied interest which attaches to the Entomostraca, it has long seemed to me that they attract a remarkably small share of attention from microscopists. In the case of so widely distributed and numerous a group, this cannot arise from any real difficulty in procuring materials for study; but I believe it does arise in great measure from a want of information as to the best means of capturing and preserving specimens. I propose, therefore, briefly to point out some of the methods which in my own hands have best answered these ends.

Classification.—The Entomostraca constitute, as all microscopists know, a division of the class Crustacea, and for the purposes of the present paper we may with sufficient approach to accuracy consider them as forming four groups—*Cladocera*, of which the common *Dapknia*, or water-flea, is the type; *Ostracoda*, typified by the little hard-shelled, bivalve, mollusc-like *Cypris*; *Copepoda*, represented by the well-known *Cyclops*; and the parasitic species, *Pacilopoda*, commonly known under the name "fish-lice."

Respecting the last-named group, I shall have nothing to say here; the mere knowledge of their mode of life indicates the method of capture.

Habitat.—All collections of still-water, large and small, from the mere road-side pool to the mountain lake and the ocean, support, with scarcely an exception, their quota of entomostracan inhabitants; nor is purity an essential condition of their existence, for sometimes they are found in great numbers when one would think the foulness of the medium too much for animal existence of so high a grade. Doubtless, however, a moderate purity of water is necessary to the presence of any great variety

of species; a luxuriant aquatic vegetation is also very favourable to the growth of most Entomostraca, affording them probably not only food, but shelter. For this reason the weedy margins of lakes are as a rule much more prolific than the clear central portions, where, indeed, but little microscopic life usually exists. Rapidly flowing water is of course unfavourable to the existence of these organisms, but the sea, both between tide-marks and in the open, abounds with them. Ostracoda, except the fresh-water Cyprides, live for the most part on the bottom, and are therefore to be obtained chiefly by dredging. The brackish water of salt-marshes and estuaries supports its own peculiar species, some of which often occur in prodigious numbers; and even the highly saline waters of brine springs and salt lakes have been found to contain Entomostraca.

Methods of Collecting

I. Freshwater.—An ordinary "ring-net," made of "hard muslin," or "crinoline," from six to twelve inches in diameter, and fitted to the end of a walking-stick, will be found the most convenient apparatus for the capture of such swimming species as haunt the weedy margins of ponds and lakes. For such shallows as are matted with a growth of *Littorella*, *Lobelia*, or other dwarf ground-plants a "horse-shoe" net, with a frame made after the fashion of a Dutch hoe, is very serviceable; while in working from a boat in the centre of a lake the ordinary ring-net on a stick will be quite sufficient. In this way the net will, after working for a few minutes, usually be partially filled with fragments of weed and other *débris*, amongst which there will also be found a fair sample of the Mi-crozoa inhabiting the locality. The coarsest fragments, such as stems of rushes and portions of water weeds, may conveniently be picked out with the fingers, and thrown away, while the rest of the contents of the net must be transferred to a bottle of clear water, an eight-ounce being a convenient size for the purpose. The Microzoa may then be readily separated by filtering into another bottle through a net of sufficiently wide mesh to allow of their passage through it : "mosquito-netting" I have found to answer well for this purpose. Having thus obtained our Entomostraca in a condition tolerably free from admixture with extraneous matter, they may easily be collected in a patch on the centre of a piece of fine muslin by passing the whole through a piece of that material, arranged over a funnel. They should then be transferred at once (if it be not wished to keep them alive) to a small phial of some preservative fluid. This may be effected easily by a penknife, but a very convenient instrument for the purpose is an ordinary quill toothpick. This process, which appears somewhat cumbrous in writing, is in reality very easily performed, but it may be still further simplified, according to the fancy of the collector, by fitting an outside funnel with a muslin net, and having a small inner one of perforated zinc, so as to do all the filtering at one operation. The collecting net may also be protected from the entrance of very coarse rubbish by a light, moveable wire grating. The species obtined by these means will often include numerous representatives of all three orders, Cladocera, Ostracoda, and Copepoda. For the capture of such Ostracoda as haunt the bottom in parts too deep to be reached by a walking-stick, a small handdredge is required : this will be more particularly noticed in the marine section.

2. The Sea.—The free-swimming species, the great majority of which belong to the order Copepoda, may be most conveniently captured by the walking-stick net held over the side of a row-boat in gentle motion. Care should be taken that the lower end of the net is as wide or wider than its mouth, and that the material, while close enough to retain the Entomostraca, is yet open enough to allow a free current of water through it: if those points be not attended to the result will be a back-wash, carrying back out of the net much which should have been retained. A towing-net dragged by means of a line from the side or stern of the boat may be used, but is not so much under control, and seldom produces so much spoil : such a net, however, attached in a tide-way during the night to some stationary object, and made with the precautions mentioned above, will often do good work, especially if its specific gravity be adjusted so as to sink very slightly below the surface. As a rule, indeed, the hours from dusk to midnight seem to be the best for capturing pelagic species near the surface. In tidal pools on the shore the same appliances are required as for freshwater ponds.

Ostracoda and other deep-dwelling species require, of course, the use of the dredge ; and where Microzoa only are the objects sought, the dredge may conveniently be made of a size much smaller than those in ordinary use. The mouth need not be more than 6 in. in its largest diameter, the bag being made of coarse canvas or " cheese cloth," and from 18 in. to 2 ft. long. The material so dredged up, after having been passed through suitable sieves, so as to separate the coarser portions, should be washed in a muslin bag for the purpose of removing all the impalpable mud, which often constitutes a very considerable proportion of the bulk : this operation may most easily be performed over the side of the boat in the sca, or in some large vessel of sea-water. The washed material is then to be put up in canvas bags, duly labelled, and hung up in a warm position to dry; the more rapidly this part of the process is conducted the better chance will there be of preserving the internal parts, as well as the valves of the Ostracoda, in good condition. But should it be wished to secure the animals actually alive, the best plan will be, after washing the mud as above explained. to immerse a quantity of it in a basin of sea water, allowing it to stand for an hour or more, when many of its inhabitants will have made their way to the surface of the water. They will, indeed, continue to come to the surface for many hours, but the later ones will probably be sickly or dead.

But besides Ostracoda, there are often great numbers of Copepoda in or on the ooze and sand of the sea bed. These require for their separation a different method of procedure; the following, so far as I know, being the most convenient. After the process of sieving described in the preceding paragraph, all the minute swimming animals will be found in the water in which that operation has been conducted; all that is necessary, therefore, is to pour the water off through a muslin nct in which the Microzoa will be retained—in a dirty state, however, which will render careful washing desirable, or still better, the transference of the whole to a bottle of clean sea water for an hour or two; in this way the little creatures will clear themselves of adherent dirt better than we can do by any amount of washing.

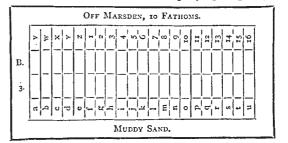
A very rich field for the collecting of Copepoda is found in the groves of Fuci and Laminariæ so common on rocky shores at and beyond low-water mark. The fronds of these weeds having been dragged up in any convenient way, are to be washed, a handful or two at a time, by brisk agitation in a tub of sea water, after which the water is to be filtered as directed above. It is best not to maccrate weeds in the water for any great length of time, because much mucus exudes from the Laminariæ, enveloping the Entomostraca, and rendering it an extremely difficult and tedious matter to examine the gathering properly. It should be mentioned that, although all weeds harbour numbers of Entomostraca, *Laminaria saccharina* is, as a rule, by far the most productive, apparently on account of the rugosities of the frond affording more efficient shelter to their minute inhabitants : sheltered pieces of coast and land-locked bays are much the most productive hunting grounds.

Treatment of Dredged Material.-The separation of Ostracoda, Foraminifera, and other Microzoa from dredged

sand or mud, is best accomplished by the process of "floating." For this purpose the material should be thoroughly well dried and sifted, so as to insure the fine division of the whole mass, then placed in a vessel of water and thoroughly stirred. By this means all the lighter organised particles—chiefly Ostracoda, Foratinin-fera, minute Mollusca, fragments of Polyzoa, &c.—will, owing to their contained air, be brought to the surface, and may be removed in any convenient way, but best, perhaps, by pouring off the supernatant water through a very fine gauze sieve. Some of the larger and heavier species will, however, sometimes remain at the bottom, and must be picked out with the help of a hand lens. *Fossiliferous Clays and Shales.*—These, after repeated

Fossiliferous Clays and Shales.—These, after repeated maceration in water, should be passed, time after time, through fine sieves, so as to wash out the impalpable suspended mud; at last drying the residuum and floating out the organic particles, as previously directed. When much fossilised, however, the Microzoa will not float. In this case they must be picked out one by one from the residuum left after the repeated washings.

Preservation of Specimens.—Soft-bodied species, e.g., Copepoda, Cladocera,&c., are best preserved in methylated spirit, either of full strength or diluted with an equal quantity of water, the latter, in my opinion, being preferable, as it does not so readily evaporate entirely if left unattended to in small bottles for a length of time. The great disadvantage of alcohol is that it coagulates the albuminous tissues, rendering the animals almost opaque, at the same time destroying the natural colour; but most other preservative solutions possess these properties to a greater or less extent, and have likewise other drawbacks, such, for instance, as becoming cloudy, permitting the growth of fungi, &c. When, however, it is especially wished to preserve the colours, a mixture of equal parts of glycerine and distilled water answers admirably. Indeed, the only hindrances to its general use as a preservative for Microzoa are its strongly solvent action on calcareous tissues and its inconvenient stickiness. For microscopic mountings (of non-calcarcous objects) some kind of "glycerine jelly" answers admirably; especially that described by Dr. Carpenter in his book on the microscope, which preparation is, however, improved by saturating with arsenious acid the water used in its manufacture. Ostracoda and other dry specimens require, of course, no preparation beyond mounting on slides of wood or cardboard. An excellent plan of mounting, so as to show at one view all the Ostracoda or Foraminifera obtained in any locality, is shown in the accompanying diagram, the



slides being made of the ordinary size, of stout cardboard or millboard. The central part of the slide is cut out, and the marginal portion mounted on another slide having a dull black ground. The slide is ruled transversely, so as to divide it into any convenient number of spaces, and if needful, ruled also with one line lengthwise down the middle. Each space is marked with a figure or letter of the alphabet referring to the species mounted within it, and an index to the whole kept in a book of reference. The diagram is a facsimile of a mounting so prepared in my collection.

GEORGE S. BRADY