

fine adjustment is generally sufficient to keep it constantly in focus, and I have no doubt that it might be adjusted well enough to use satisfactorily as high a power as a long-focussed quarter-inch objective.

Indeed, the instrument has proven to be all that could have been expected of it as an orienting microscope, and, at the same time, its value for ordinary work is in no way decreased, unless the slightly less rigidity of the stage is an objection.

Plans have already been completed for a dissecting microscope for use in my laboratory embodying the same principal but involving greater changes from instruments now in use. The new stand will consist of a stage which remains horizontal, so that insects may be dissected on it under water. The arm is jointed and the lower section bent so that the axes of the two hinges are at right-angles to each other. There will be the necessary arrangements for so adjusting these axes as to make them intersect, and the tube will be fitted with a nose-piece adjustment.

The base will be clamped to the desk for sake of rigidity. The focussing will be all done at the stage, though the tube will move to accommodate the varying focal-lengths of the objectives.

It is expected to use the objective under water, providing it with a hard-rubber shield having a cover-glass on the end. This kind of instrument should be also very useful for the study of aquatic forms.

SUMMER WORK IN MARINE ZOÖLOGY AT NEWPORT.

BY W. E. CASTLE.

OUT on the extreme southwestern point of the Island of Rhode Island, in Narragansett Bay, is Castle Hill, the comfortable residence of Mr. Alexander Agassiz. Against this point the waves of the Atlantic break with full force as they sweep round the east end of Long Island past Point Judith. This is the one rough spot in the trip from New York to Boston by boat.

As the tide comes in at Castle Hill and passes the narrow entrance of the bay, it makes a bend and carries its rich pelagic life into a little cove on the north side of the point. On this cove is Mr. Agassiz's laboratory.

It is a modest-looking little structure, modelled after a Swiss cottage, but within it is a very paradise for the marine zoölogist.

Aquaria, tanks, and glassware it contains in abundance, while fresh and salt water are carried in pipes to all parts of the laboratory. Fresh, salt water, and air to aerate the aquaria are pumped in by a wind-mill.

Mr. Agassiz carries on his own investigations in the smaller room at the west end of the building. The larger room of the ground floor each summer he generously puts at the disposal of a certain number of students from the Museum of Comparative Zoölogy at Cambridge, Mass.

Any day through the summer you may see half a dozen men here industriously bending over their microscopes, studying animals in their living form or preserving material for future study. On account of the extreme moisture of the atmosphere, little balsam mounting or clearing can be done at the sea-shore, so that work of this kind is usually postponed to be done at Cambridge during the fall and winter months.

Each morning at nine o'clock a hack from the boarding-house in town puts the men down at the laboratory door. It calls for them again at five, after their day's work is ended.

About ten o'clock each evening "Thomas," Mr. Agassiz's faithful man-of-all-work, rows slowly up and down the cove skimming the surface of the water with a tow-net. From time to time he lifts the net of fine cheese-cloth carefully from the water, turns it inside out and dips it repeatedly in a bucket of water.

The soup thus obtained is carried into the laboratory, diluted, and poured out into half a dozen glass dishes placed on black tiles.

Around these dishes the men gather upon their arrival in the morning, each furnished with pipettes and watch-glasses of various sizes. Every nook and corner of the dish is carefully scanned with naked eye and with the aid of lens, and in different lights, that no egg or larva, however minute, may escape notice.

After a man has acquired a general knowledge of the pelagic

fauna, he usually confines his attentions to some particular group of animals, and the tow is sorted out and divided accordingly.

One man studies the mollusks, another the echinoderms, another the jelly-fishes, and so forth.

The tow is the chief source of material for study. It is supplemented, however, by dredging from the steam-launch, and shore collections at low tide.

The laboratory contains a good library of general works of reference, while literature on special topics is supplied from Mr. Agassiz's private library and from the museum library at Cambridge.

Not least among the advantages afforded to the training investigator are the helpful suggestions of Mr. Agassiz himself, whose long experience in marine work makes him an invaluable adviser.

With such excellent opportunities for advanced work in zoölogy, it is not surprising that in this little laboratory material has been gathered for many scientific papers of a high order, and that here many of the best zoölogists Harvard College has produced have received an important part of their professional training.

BACTERIOLOGY IN THE DAIRY.

BY C. C. GEORGESON, MANHATTAN, KANSAS.

THE bacteria which affect the quality of our dairy products may, for practical purposes, be classed under two heads, namely, those which are beneficial, and those which are injurious, and it is as essential to encourage the one as it is to wage a constant war upon the other. It has been established beyond a peradventure that the pleasant flavor and aroma of good butter are developed by certain species of bacteria present in the cream and instrumental in producing the changes which take place during the process of fermentation usually termed "souring." And it is equally well established that there are certain other species which, if permitted to get the mastery, will, as it were, overpower and neutralize the influences of the former class and give a disagreeable taste and smell to the butter. Both classes are present in all dairies, and the skill and success of the butter-maker depend in large degree on the recognition of this fact and his ability to foster the growth of the beneficial bacteria and to keep the injurious kinds in subjection. His chief weapon against the latter is cleanliness. Filth of every description is their best breeding-ground. But it also happens that the conditions are such, in surroundings over which the butter-maker has no control, that, in spite of the strictest cleanliness on his part, the injurious organisms propagate too fast and deteriorate his products. Again, it may lie in the health, feed, or other conditions affecting the cows from which the milk is drawn. Under such conditions, what is he to do? It is the solving of this problem which has brought bacteriology into intimate connection with the dairy business; and the honor of solving it and thereby ensuring the production of "gilt-edge" butter under naturally adverse conditions belongs to the Danes.

In practical dairying there are two forms of physical means by which the growth of bacteria may be controlled, namely, cold and heat, relatively speaking. At a temperature at or near the freezing-point the active growth of the bacteria ceases, and hence the reason for keeping the milk cool by the use of ice. The cold produced by the ice does not kill the organisms or purify the milk, it simply retards their multiplication, and thus affords time for the dairy operations to take place before they work injurious changes. Heat, on the other hand, kills the bacteria. At the boiling-point nearly all those forms ordinarily found in milk are destroyed. But, as this high temperature affects the taste of the milk or cream by imparting the characteristic "boiled taste," in practice the temperature is raised to but 75° or 80° C., at which point the taste is not materially affected, and still the greater portion of the bacteria are killed.

This much known, the Danes have gone a step farther. They have isolated and perpetuated "pure cultures" of those forms which they have found to be beneficial to the production of first-class butter, and by impregnating the cream, under proper conditions, with these artificially grown bacteria they give their butter the desired flavor and aroma. It is now between two and three