

anastomose somewhat. They project into the jelly tissue that fills the remainder of the compartment.

A remarkable feature is the striation of the substance of the electroplax. Even in the poor alcoholic material at my command, it stands out almost as marked and clear as in striated muscle, and it has much the same structure. As in *Raja*, these lines of striation are parallel but not straight; but, differing from *Raja*, they have an intermediate line and they are found in all parts of the papillæ and up to the electric layer. The presence of so much striated substance does not accord with Ballowitz's view of the specialization and efficiency of electric tissue. That so small an organ should give so marked a shock puts it on a level with *Gymnotus* and *Torpedo*, both of which are supposed to have specialized their striated substance out of existence by developing the network for greater power.

However, it is not proper to go further into the question until I have prepared fresh material and studied the details of nerve endings, 'rod-net,' and coarse and fine network. Mr. C. F. Silvester has undertaken to work out the gross anatomy as part of this paper.

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A NEW METHOD OF COLLECTING EARTHWORMS FOR LABORATORY USE.

For the benefit of teachers of biology who use the earthworm as one of the laboratory types it has seemed worth while to briefly report a method which has been successfully employed in my laboratory during the past two years, and which in the saving of time and labor we have found a very great improvement over the old methods of capturing them at night by the aid of a lantern, or by digging over the earth by means of a spade or such implement.

The method was first called to my attention by the care-taker of the golf greens on the university campus, who used a proprietary article, sprinkling it over the greens, following which the worms would emerge in great

numbers from their burrows, and were then swept up and destroyed, thus relieving the surface of the annoyance of the castings.

This preparation is known by the name of 'Rushmore's Concentrated Worm Destroyer,' and may be had by the barrel of the manufacturer, Garden City, N. Y. It is, as indicated, a concentrated liquid, and for use must be diluted with about one hundred and fifty times its bulk of water. In using, it is simply sprayed over the lawn, where worms are known to abound, from an ordinary watering pot till the surface is well saturated. Within five minutes, usually, the worms begin to emerge from their holes and may be collected and placed at once in clean water, which should be changed several times in order to remove all trace of the irritant, in order that they may not distort themselves and thus be injured as specimens. They may then be narcotized after the usual method and preserved in either alcohol or formalin. In using such specimens for dissection they have been found to be quite as good as those taken by older modes of collection.

We have found it quite important to use a greatly diluted preparation, otherwise it tends to drive the specimens deeper into the burrows and thus fail of its object.

Commenting upon the method among some of the students it was discovered that similar methods have been used by others, though involving greatly differing media. For example, it was said that when using a very dilute solution of corrosive sublimate, one part in ten thousand, for killing potato 'bugs,' in many cases earthworms would emerge in the same manner as in the former. Again, it was also learned that to obtain angle worms for bait a decoction of mustard in water had been sprinkled over the ground, in response to which specimens would readily come to the surface.

It would seem, therefore, that probably any of several such means might be employed successfully. The proprietary article has a considerable use among keepers of golf links, and where so used one may easily take advan-

tage of it to secure an abundance of specimens at little or no cost.

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SPECIAL ARTICLES.

EFFECT OF DRYING UPON LEGUME BACTERIA.

THE almost simultaneous appearance of Bulletin No. 270 of the Geneva (New York) Experiment Station and Farmers' Bulletin, No. 240 of the United States Department of Agriculture, the one stating that cultures of nodule-forming bacteria dried on cotton were worthless for practical purposes and that the failure of these cultures was inherent in the method of their preparation, the other stating that the Department of Agriculture did not consider cultures dried on cotton entirely satisfactory and would instead distribute liquid cultures hermetically sealed, has perhaps naturally resulted in unwarranted and unfairly severe criticism toward the cultures dried on cotton.

The most misunderstood feature in the deterioration of dried or partially dried cultures is the distinction between the effect of desiccation *per se* and the effect of small quantities of moisture present for some length of time, either because of slow drying or because of absorption of water vapor from a humid atmosphere after the cotton had been thoroughly and rapidly dried. It has, therefore, been considered desirable to publish at once an explanation of the simple paradox that the rapid drying of cultures of nodule-forming bacteria causes a relatively insignificant injury to them, while the partial drying of similar cultures will cause them to deteriorate and die rapidly. The time of danger to a drying culture is the time of high concentration of the soluble substances. This condition necessarily obtains when the culture is almost dry. Whether one wishes to base his explanation chiefly upon the antiseptic action of concentrated sugar and salt solutions¹ or

¹ Sternberg, 'Manual of Bacteriology,' 1893, p. 156.

² John Golding, *Journal of Agricultural Science*, Vol. I., Pt. 1, p. 59-64.

upon the deleterious action of by-products² which must also be highly concentrated in the almost dry culture, it is necessary to admit that the longer a given culture is exposed to these adverse conditions the fewer bacteria will be able to survive; and as the necessary corollary, the more often a properly dried culture is allowed to become moist the greater will be the deterioration of that culture.

This explanation is deduced from the following facts:

1. Cultures of nodule-forming bacteria have been rapidly dried, kept in a desiccator for thirty days, sixty days and ninety days, and revived with no apparent difference in the three series.

2. Cultures dried as above have been exposed to moist air for ten days and for twenty-four days. In some cases contaminations destroyed the proper organism; in others complete sterility obtained; in a few cases a few organisms remained in cultures otherwise sterile.

3. Cultures ten days old were evaporated in vacuo, and into the concentrated broth heavy inoculations were made. These tubes were sterile at the end of seventy-two hours.

4. Our regular sugar-broth was made up approximately twenty times as concentrated as our regular formula, and this medium was heavily inoculated with actively growing cultures. By the end of seventy-two hours these tubes were sterile.

5. A culture has been placed on cotton, half of which was placed in a sterile petri dish, to make drying very slow, half was dried rapidly and kept over calcium chlorid. After twenty-five days the cotton in the petri dish was sterile; the cotton from the desiccator was a pure culture in good condition, containing numberless organisms.

We may summarize briefly as follows:

The nodule-forming bacteria of the Leguminosæ may be dried rapidly and kept in a dry condition for long periods,³ and may then be revived successfully.

Cultures properly dried may be killed by exposure to moist conditions.

³ See also Bulletin No. 71, Bureau of Plant Industry.