sides and dorsum of the anterior 15 to 20 somites. Then the septa or any other parts which obscure the desired structures should be picked away by means of fine-pointed forceps, the points of which have been made sharper by filing or grinding. This work with forceps must always be done under a binocular microscope, and brilliant illumination must be employed. The hearts and certain other parts, if broken in the process of dissection, may be cemented in place by means of white shellac, or euparol.

One of the easiest preparations to make and, at the same time, most useful is made by splitting the anterior 17 to 20 somites in the mid-dorso-ventral plane. Such a preparation reveals all the parts of the digestive system from mouth to intestine. The muscles radiating out from the dorsal wall of the pharynx to the body wall are shown here better than in any wet dissection, or in sections. The openings of the calciferous glands are revealed as large openings a short distance anterior to the crop. Other organs which may be readily identified by any student are the brain, ventral nerve cord, ventral and dorsal blood vessels, parts of nephridia, seminal receptacles and septa. Posterior to the gizzard the mesentery supporting the sub-intestinal bloodvessel may frequently be seen as a plate of thin tissue traversed by branches of the sub-intestinal vessel. In preparations similar to the above the esophagus may be dissected out by means of the fine-pointed forceps. This will lay bare complete nephridia, seminal vesicles, seminal receptacles and many of the finer ramifications of blood vessels. From such preparations the student can gain a better appreciation of the coelom than can otherwise be had. Other useful preparations may be made by cutting parallel to the ventral surface, either above or below the nerve cord which may then be seen with its ganglionic swellings and frequently with unbroken nerves. If the cut is below the nerve cord the subneural blood vessel may be seen applied to the cord with its branches extending along the ventral surface of the nerves.

To show the relationship of setae to the body wall, the muscles which tilt the setae, and the muscle which unites the tip of the ventro-lateral pair of setae with the lateral pair of each half somite cut a strip of the lateral body wall so as to include the two rows of setae and view it from the inner surface. No other kind of preparation that I know of shows these structures so well. Many other dissections have been made, but those described above are sufficient to illustrate the method and to suggest possibilities to the experienced laboratory worker.

The dried preparations have several advantages over wet dissections. Dry surfaces do not reflect the light as do wet surfaces. Outlines appear sharp, there being no fuzziness of the image due to reflections below, or from, the surface of the water. By using a variety of dry preparations, structures can be seen from different points of view than in conventional dissections. This is especially valuable after the student has made his dissection and has studied cross sections. The making of the dried preparations is not difficult, nor especially time consuming, and their preservation is simple. They may be studied with the simple dissecting microscope or with the binocular.

The dissections of dried forms may be mounted on blackened blocks of wood, using glue or shellac as the adhesive, or they may be glued to black paper which has been glued to small blocks of wood. Under no consideration should the preparations be mounted under glass, since reflections from the glass, dust on its surfaces and absorption of light by the glass interfere seriously with good vision. It is better to make new preparations from time to time than to protect them with glass coverings.

Further refinements of this method remain to be worked out and it is hoped to report on them at a later time.

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A SIMPLE SHAKING APPARATUS FOR USE IN ENZYME STUDIES[1]

IN the course of our digestion experiments with castor bean lipase, it was found necessary to devise a shaking apparatus in order to overcome certain conditions that prevented concordant results from being obtained from day to day.

The apparatus used by us, as shown in Figure 1, has given very satisfactory results in our enzyme studies and was constructed as follows:

An old incubator was heated by means of a carbon lamp, the temperature being controlled by means of an electric thermoregulator with condenser. A thermograph was attached to record temperature fluctuations that were found never to exceed $\pm$ .5° C. A grooved wooden wheel ten inches wide and one half inch thick was employed to hold the bottles containing the digestion mix. These bottles were of five cc capacity and were prepared from hard glass ignition tubes of 13 cc capacity. They were held in place by means of copper wire extending through minute perforations in the wheel, the base of the bottles resting in small borings extending partly through the wheel, the dimension of the borings approximating that of the bottles themselves. The wheel was allowed to revolve at 60–70 R. P. M., the power being supplied by a small motor placed outside the incubator and controlled by means of a rheostat. In order to eliminate

[1] Contribution No. 3 from the Department of Agricultural Chemistry, the Pennsylvania State College. The drawing is by Mr. Walter Trainer.

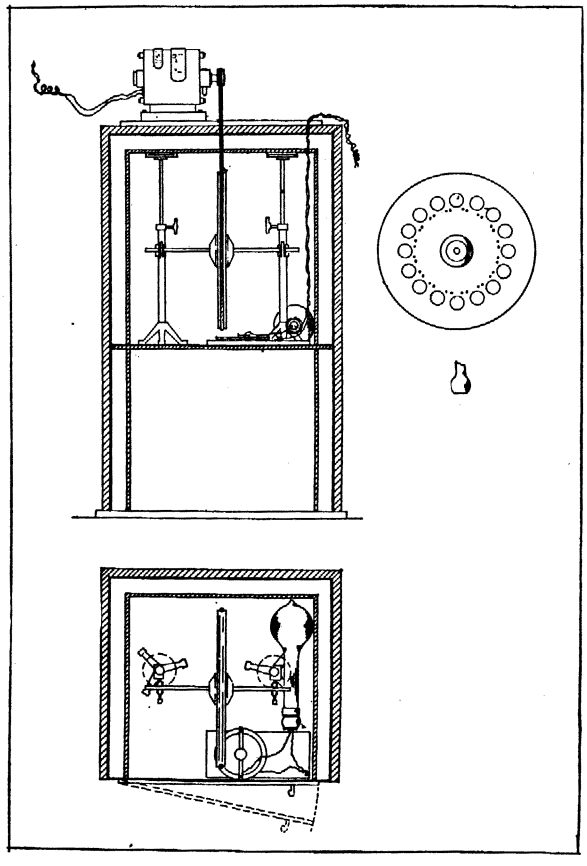

FIG. 1.

the possibility of absorption, the corks of the small bottles were covered with paraffin. This apparatus is to be particularly recommended for studies of this nature, in view of the fact that it can be duplicated readily from materials commonly found in the ordinary chemical laboratory and at a very low cost. If an incubator is not available any similar apparatus properly insulated can be used instead.

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SPECIAL ARTICLES

FURTHER EVIDENCE OF INSECT DISSEMINATION OF BACTERIAL WILT OF CORN

IN two previous papers[1] the writers have discussed some of the results of their experiments and field observations relative to bacterial wilt or Stewart's disease (*Aplanobacter stewarti* EFS emend McCul.) of corn. The cage experiments of 1922 with the brassy flea beetle (*Chaetocnema pulicaria* Melsh.)[2] demonstrated its agency as a carrier in the secondary spread of wilt during mid-season—a hitherto puzzling factor. Similar experiments in 1923 have abundantly confirmed these results and have added the toothed flea beetle (*C. denticulata* Ill.)[2] as a direct disseminator. Briefly, in several field tests aggregating sixteen cloth covered hill-cages, into each of which had been introduced twelve to fifty wilt-fed flea beetles, the final result gave a total of eight healthy plants and forty plants with bacterial wilt. That is, 83 per cent. of the plants in the cage tests contracted the disease.

In 149 control cages into which no insects were experimentally introduced there were 436 healthy plants and five plants with wilt. Of the latter, three cases with abundant yellow ooze characteristic of the disease, and accompanied by small larval channels in the base of the stem, occurred in two hills not caged until the plants were two to three inches tall. A fourth case with yellow ooze and larval channel occurred in a cage together with four healthy plants bearing external evidence of insect injuries at the base of the stem. The last case showed no ooze or bacteria in the stem, but on a leaf blade there were several wilt streaks starting from injuries due to flea beetles. Thus, with exception of five cases of external origin there was no wilt throughout the season in the 441 caged control plants.

The direct dissemination from diseased to healthy plants through the agency of flea beetles easily explains a large part of the mid-season spread of corn wilt, which often makes up the bulk of its seasonal incidence. They leave largely unexplained the sporadic cases of primary infection which appear early in the season without any apparent relation to external dissemination and which seem to originate from within the plant itself, that is, from the stem upward. These cases were at first supposed to come largely from infected seed and possibly also in some instances from infected soil. However, our field and greenhouse experiments during several seasons have clearly pointed away from soil infection as a factor and have apparently brought seed transmission within much narrower limits. From data previously discussed (*loc. cit.*) it may be repeated that under controlled conditions 2 per cent. of wilt is the highest amount obtained from seed collected from badly diseased plants. This evidence, however, does not minimize the importance of seed transmission in introducing wilt into

[1] Rand, Frederick V., and Lillian C. Cash, "Stewart's disease of corn," *Jour. Agric. Research*, 21: 263–264, 1921.

Rand, Frederick V., "Bacterial wilt or Stewart's disease of corn," *The Canner*, 56: 164–166, 1 fig., 1923 (No. 10, Pt. II).

[2] Identified by the Bureau of Entomology.