The aims of *Biological Abstracts* are more praiseworthy in this respect, I think. These are, as I understand them, to enable the reader to read more, not less; to enable him to read more widely by furnishing titles and references and to read more discriminatingly by adding a brief statement of scope of work covered and conclusions drawn, and to give such indexes as to provide a dependable orienting mechanism. More lengthy "Berichte" will continue to fit into the scheme, especially in helping one keep in touch with related fields (Grenzgebiete) and other fields in which one happens to be an interested amateur.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

NEW TECHNIQUE FOR COLLECTING INTESTINAL ROUNDWORMS[1]

THE isolation of small roundworms from the intestinal contents of host animals is recognized as a difficult and tedious task. As the intestine loses the body heat, the mucous secretions from the intestinal glands pour into the spaces between the villi and soon all other material in the lumen of the intestine becomes imbedded in viscid, opaque mucus, which not only obscures any small nematodes present, but renders their isolation difficult. Experimental studies on the larvae of ascarids and closely related forms which do not become attached securely to the intestinal mucosa have led to the plan of keeping the host animals off feed before autopsy, of prompt removal of intestinal contents and of the use of mucus solvents. But in spite of these precautions, the isolation of the larvae has been a slow, laborious process.

During the past year while working with larvae of the large roundworm (*Ascaridia lineata*) of chickens some new features were added to the technique which so greatly facilitate the removal and isolation of the young worms that it seems desirable to make a record of them. By the new method the experimental birds are kept off feed over night, or for six hours prior to autopsy, to decrease the volume of intestinal contents. After the bird is decapitated, the small intestine (habitat of the nematodes) is quickly removed, stripped of its mesenteries and other appendages and divided into portions approximately a foot in length. Each portion is then flushed with hot water under pressure, to remove the contents before the intestinal glands become active. In flushing, one end of the intestine is held over the flushing cone (Fig. 1, *a*) and the other end inserted into an Erlenmeyer flask. The amount and pressure of the hot water admitted into the intestine are such as to distend but not rupture the walls of the intestine. This enlarges the spaces between the villi, and thus permits free hydraulic action on all the intestinal contents. These contents from each bird are placed in a glass jar and preserved in 4 per cent. formol. To remove the worms the material is decanted, stained with Jenner's stain, poured into a shallow moist chamber and examined with low-power binoculars. The white worms, which do not readily take up the stain, stand out in contrast to the blue intestinal débris.

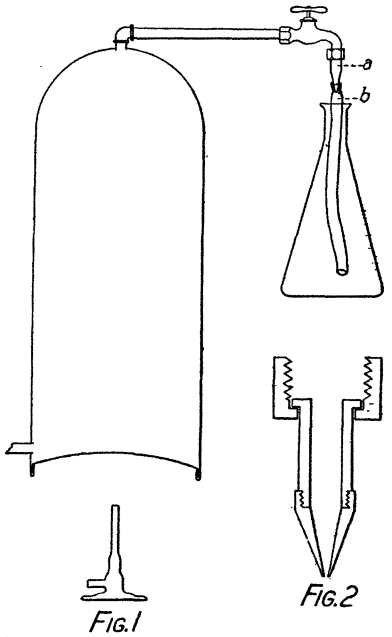

FIG. 1. Apparatus for flushing intestinal contents. *a*, flushing cone; *b*, portion of intestine showing distention due to pressure of water.
FIG. 2. Details of flushing cone.

The question of the efficiency of this method was, of course, one of the first to arise. In several preliminary trials, young worms were readily isolated from the flushed contents, but were not found in scrapings from the walls of the flushed intestines. Arrangements then were made for definite tests, and two experiments were carried out. After flushing the intestines in the usual way, they were slit open, the mucosa scraped, the material teased apart and examined with the aid of a binocular microscope.

In the first experiment, the individual chickens were parasitized at the age of five weeks by the administration, *per os*, of fifty embryonated eggs of the nematode. Eight weeks later a second feeding of embryo-

[1] Contribution No. 115 from the department of zoology, Agricultural Experiment Station, Kansas State Agricultural College.

nated eggs was given and after three weeks the experiment was terminated. Examination of the flushed intestinal contents of the fifty-seven chickens gave 133 nematodes, whereas in the scrapings of the intestinal mucosa no worms were found in any case. The technique worked admirably with both small and larger worms, the range in length being from 3.2 mm to 95.2 mm. Numbers of worms likewise caused no difficulty, for as few as one and as many as twenty-five worms were present in a chicken. Thirty-three per cent. of the birds were infested at autopsy.

In the second experiment, thirty chickens were parasitized at the age of nine weeks by giving to each bird fifty embryonated eggs of the nematode. Two weeks later the experiment was terminated with results similar to those of the first experiment, *viz.*, that from the flushed intestinal contents 186 worms were isolated, while in the scrapings of the mucosa of the same intestines not a worm was found. The percentage of infested birds in this experiment was 92; the range of individual infestations was from one to thirty-three worms, and the lengths of the worms varied from 2.1 mm to 11.5 mm. The results of these experiments give evidence that the technique is highly efficient in the removal of roundworms from the intestines of chickens.

The temperature of the water for flushing the intestine may vary many degrees and still be effective. Temperatures above 60° C. and below 35° C. caused contractions of the muscles of the intestine and thus interfered with distention and free flushing.

While the technique is especially valuable for small worms, it works equally well with larger ones, and should be readily adapted to studies on the various larval and adult nematodes, living free in the small intestine of birds and reptiles and of small and medium-sized mammals. Apparatus such as shown in Fig. 1, while desirable, is not necessary for the application of this technique. The flushing cone (Fig. 2) can be used on any hot-water faucet to which a hose couple can be attached. It was made by threading a small brass cone on a hose couple.

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PARAMECIUM BURSARIA AS A LABORATORY DEMONSTRATION OF CYCLOSIS

THE use of *Paramecium bursaria* for demonstration of cyclosis in laboratory classes in zoology has several possible advantages, as compared with the customary use of Nitella. In the first place, it obviates the necessity for drawing on the plant kingdom for illustrative material. Furthermore, this ciliate may be maintained easily in laboratory cultures at any season of the year, and in addition it furnishes, with its contained Chlorella, an excellent example of symbiosis.

Cyclosis is unusually rapid in this species of Paramecium, and is readily followed under a 4 mm objective. The writers have found that especially interesting preparations may be made by staining vitally with neutral red. Clean slides, after being warmed slightly over a flame to eliminate excess moisture, are filmed with a solution of neutral red (1:1500, or more dilute) in absolute alcohol. After the film has dried a drop of culture material is added, and a cover-slip sealed in place with melted vaseline. Numerous small scattered globules are stained with neutral red, and these add to the clearness with which cyclosis may be observed. In addition, this method affords a good laboratory demonstration of the effects of vital dyes on a protozoon, while the neutral red also serves as an indicator of the pH of the inclusions. If the dye solution is dilute enough, the organisms should live for twenty-four hours or more; hence, if several laboratory sections are to be supplied, the same preparations may be used in successive laboratory periods.

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SPECIAL ARTICLES

MICHIGAN PAPYRUS 620; THE INTRODUCTION OF ALGEBRAIC EQUATIONS IN GREECE

THE Egyptians some two thousand years before the Christian era set up equations of a purely algebraic type. In one type of these problems, as given in the Ahmes Papyrus,[1] an unknown number with some fractional part of it is set equal to a known number and the solution is effected by the so-called method of false position. In other problems[2] two unknowns appear as the sides of a rectangle with known area, and their ratio being given, the two unknowns are determined. The brief translation of portions of the Moscow papyrus given by Touraeff[3] also indicate that the analogous problems which appeared in Euclid's Data had their beginnings in ancient Egypt. The eagerly awaited complete trans-

[1] T. Eric Peet, "The Rhind Mathematical Papyrus," Liverpool, 1923.

[2] H. Schack-Schackenburg, "Der Berliner Papyrus 6619," *Zeitschrift für Ägyptische Sprache und Altertumskunde*, Vol. XXXVIII (1900) and Vol. XL (1902).

[3] B. Touraeff, "The Volume of the Truncated Pyramid in Egyptian Mathematics," "Ancient Egypt," 1917, pp. 100–102; L. C. Karpinski, "An Egyptian Mathematical Papyrus in Moscow," SCIENCE, 57 (1923): 528–529. In the article in SCIENCE I pointed out the importance of the other problems to which Touraeff refers. L. C. K.