graph. Its lower edge should reach about 1 in. below the gap between drums (A) and (B).

The capillary (F) is clamped on a ring stand by means of a cork, as shown, so that the slightly bent tip of the capillary is pressed against the paper. The tip must be fire-polished to prevent scratching of the paper. The kymograph is then set in rotation and the solution to be

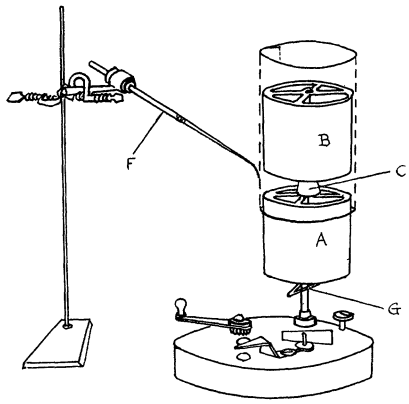


FIG. 1.

applied is added to the capillary tube. Unless this solution is absolutely free from solid particles a small cotton plug should be inserted in the capillary to serve as a filter. A heat source is used to facilitate evaporation of the solvent. A 250-watt infrared lamp has been found useful for this purpose. The band width is determined by the rate of flow of the solution, and may be regulated both by the size of the capillary opening and the speed of rotation of the kymograph. Flow rates can also be readily varied by applying gentle air pressure to the capillary.

By this method it has been possible to apply a 5-ml fraction of a methyl alcohol solution to a sheet of Whatman No. 1 paper in less than 15 min, and at the same time maintain a narrow band of material. The amount of any substance which should be applied in this manner is, of course, ultimately limited by the sharpness of the separation which can be obtained on the paper, and will vary in each case.

After the paper is dry and removed from the drum, any standard method can be used for developing the chromatogram. The authors have found it suitable to cut the sheet into two sections, 13 in. and 7 in. wide, respectively. These can then be stapled into two cylinders, which are simultaneously developed as ascending chromatograms in a glass-covered cylinder, 6 in. in diam and 18 in. high, containing 100 ml of developing solvent. A small section of the developed chromatogram is cut off lengthwise and used in order to detect the position of the desired substance if its $R_f$ value is not already accurately known. Once this has been ascertained, the entire desired section of the paper can be cut out and the material eluted by shaking with successive portions of an appropriate solvent, or by treating the paper with the solvent in a Waring Blendor.

Many different thick filter papers have been tested for suitability in the separation of larger amounts of material. The most satisfactory paper tested so far is Schleicher and Schuell paper No. 470-A[1] (0.025 in. thick). The separation on this paper is not as good as on thinner paper, but has proved very satisfactory for the initial separation of large amounts of material.

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## Relationship in Mice of Intestinal Emptying Time and Natural Resistance to Pig Ascaris Infection

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Rapid intestinal emptying time of young mice is involved in their high degree of natural resistance to the cestode, *Hymenolepis nana* var. *fraterna* (*1*). This emptying-time factor also appears to be operating in the distribution of *Trichinella spiralis* in the intestinal tracts of mice (*3*). It was, therefore, of considerable interest to learn from preliminary experiments that young mice, as compared with guinea pigs, have a remarkable degree of natural resistance to infection with pig ascaris (*Ascaris lumbricoides suum*). The aim of the present study is to determine the relationship of intestinal emptying time and natural resistance to infection for this parasite in mice.

The first three experiments were carried out using female mice, two months old, to establish the minimal infecting *Ascaris* egg dose. The methods of obtaining mature embryonated eggs and infecting the animals have been described earlier (*2*). One half of the mice in each egg-dose group were sacrificed between the fifth and eighth day after attempted infection so as to observe grossly the appearance of the lungs and to search for migrating larvae in that organ. This determination was qualitative only and was made by pressing small pieces of the entire lungs between two glass slides. These slides were examined microscopically with 100 × magnification. The remaining half of the mice were observed daily for 20 days to establish survival rates.

In the first experiment, the mice were divided into five groups of six mice each. Those of group 1 received 600 eggs. This dose for each succeeding group was increased by 600 so that the mice of the last group, group 5, received 3000 eggs. None of the mice showed outward evidence of infection, and of those autopsied the lungs appeared normal and were negative for larvae by the

[1] The author acknowledges with appreciation the technical assistance of Miss Dolores Stough during a portion of the study.

[1] Sample sheets of this paper were kindly furnished by the Carl Schleicher and Schuell Company of New York City.

microscopic method described. In experiment 2, seven groups of four mice each were used. In this case the egg dose for the mice of group 1 was 3600. This was increased by 1200 in each succeeding group so that the animals of group 7 received 10,800 eggs. The results were the same as for experiment 1. In experiment 3, seven groups were used, each with four mice. Those of group 1 received 12,000 eggs. This dose was increased by 3000 in each succeeding group, so that the mice of the last group, group 7, received 30,000 eggs. Except for group 7, the results were identical with those of experiments 1 and 2. The two mice of group 7 autopsied six days after infection showed a few hemorrhagic spots on the surface of both lungs; 15 and 25 larvae, respectively, were observed in pressed lung sections. The remaining two mice of group 7 were in apparent good condition 20 days after infection.

Although the number of animals was small, the results suggest that an egg dose of about 30,000 is the minimal infecting dose for mice. This agrees with the minimal dose used by Sprent and Chen (*4*) in a recent study. Thus, mice have a strong natural resistance to infection with this parasite, as compared with guinea pigs, which can be infected with egg doses as low as 6600 (*2*).

Experiment 4 was also performed with female mice two months old, to determine whether the rapid intestinal emptying time of mice of this age (*1*) is a factor in their striking resistance to infection as demonstrated in experiments 1–3. The method of artificially slowing the emptying time of experimental mice with 1% morphine sulfate was the same as that used in an earlier study (*1*). Sixteen of the mice were divided equally into experimental and control groups. The morphine was injected into the experimental animals, and 15 min later all of the mice were given 12,000 eggs, or less than one-half the established minimal infecting dose. The effectiveness of morphine in slowing the intestinal emptying time was verified by determining the passage of carbon ink in three additional mice (*1*). Six days after infection, one half of the experimental and control mice were sacrificed. The lungs of the controls appeared normal, and no larvae were found in pressed sections. This was expected from the results of experiment 3. However, three of the four mice given morphine sulfate prior to infection showed considerable lung hemorrhage, and an average of 150 larvae was observed. The remaining four mice of the control group showed no outward evidence of infection during the 20-day observation period. On the other hand, one of the remaining four experimental mice died on the ninth day of infection, apparently from lobular pneumonia caused by the larvae. The other three mice of this group, although showing signs of respiratory involvement, survived the infection.

It is clear from results of experiment 4 that mice given morphine sulfate as described were rendered considerably more susceptible to infection with *Ascaris* eggs than untreated controls given the same number of eggs. In fact, the drugged mice appeared to be more heavily parasitized than the nondrugged mice in experiment 3, which had been given more than twice as many *Ascaris* eggs. Other factors in this resistance may be affected by morphine, but the most reasonable explanation for increased susceptibility of drugged mice is the reduced intestinal emptying time, which presumably allows greater numbers of eggs to hatch than in control animals. Thus, the rapid intestinal emptying time of young mice is probably an important factor in their strong resistance to initial infection with pig ascaris, as was demonstrated earlier for natural resistance to *Hymenolepis* (*1*).

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## Electrometric Titration of Some Functional Groups


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Although simple titrimetric methods are available for quantitative analysis of many different types of inorganic compounds, relatively few organic compounds lend themselves to rapid volumetric analysis. Carboxylic and amino compounds, which can be titrated because of their

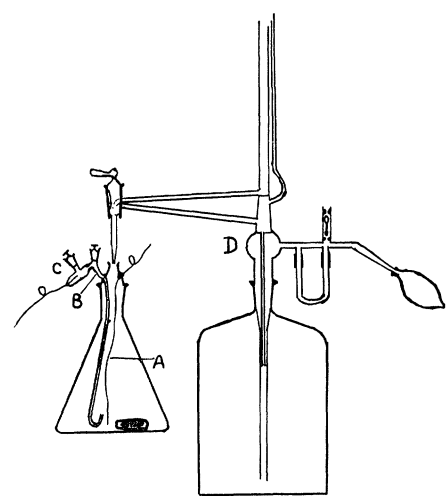


Fig. 1. Schematic drawing of the apparatus.

acid-base property, and olefinic compounds, which can be determined by iodine or bromine titration, represent the main types of organic compounds usually assayed volumetrically. A brief description is given in this preliminary report of a relatively simple electrometric method for the volumetric analysis of several functional groups

[1,2] Fellows, American Foundation for Pharmaceutical Education.