THE COMPARATIVE EFFECT OF TWO IRON SALTS ON PARASITIC ANEMIAS IN PUERTO RICO[1]

A COMPARATIVE study has been carried out on the effect of iron ammonium citrate (ferric) and iron sulfate (ferrous) on the anemias associated with hookworm disease and with schistosomiasis mansoni.

The response to large daily doses per os of iron ammonium citrate (6 gms) in hookworm anemia has been reported by several investigators.[2,3,4] Rodríguez-Molina and Pons[5] have studied the effectiveness of this drug in the anemia associated with the intestinal phase of schistosomiasis mansoni. This condition is produced by a unisexual blood fluke living in the portal vessels of its most common host, man. It produces chronic dysentery, and later, fibrous and papillomatous growths in the lower intestinal tract, cirrhosis of the liver with splenomegaly and anemia.

In hookworm disease the administration of each of the therapeutic agents used (6 gms iron and ammonium citrate; 1 gram iron sulfate, daily) during a period of thirty days without removal of the worms resulted in a rise of the red cell count and hemoglobin percentage to a practically constant subnormal level accompanied by definite clinical improvement. After removal of the worms the blood values rapidly rose to normal levels (5 to 7 days).

In schistosomiasis mansoni, however, 2 gms of iron sulfate were required to produce improvement in the red cell count and hemoglobin percentage, compared to that obtained with the use of 6 grams of ammonium citrate.

From the above evidence, it is suggested that the administration of iron sulfate (in the solid form) is easier and less bothersome to the patient than the use of a solution of iron ammonium citrate. Gastrointestinal disturbances such as diffuse abdominal pain and diarrhea have been observed during the administration of both drugs, but are less frequent when iron sulfate is administered.

The difference in the quantity required of the two drugs employed in this study might possibly be explained in terms of degree of oxidation of the iron or a difference in its assimilability in the gastrointestinal tract.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

RAISING THE PRAYING MANTIS FOR EXPERIMENTAL PURPOSES

PHYSIOLOGISTS and psychologists have long sought an insect suitable for experimentation. Grasshoppers, bees and cockroaches have been the subjects of various investigations but have definite limitations, either being too small for satisfactory operative techniques or flying or jumping, making accurate observation difficult. A number of generations of the praying mantis have been raised in this laboratory over a period of four years, and this insect has proved ideal for experimental purposes. At the moment it is being used in an investigation of the functions of various ganglia and in studies on insect vision. It is therefore felt that a brief description of the insect and methods for raising it might be of interest to those seeking material for psychophysiological experiments.

The species used is *Mantis religiosa*—a species accidentally introduced into this country from southern Europe. The adult female is four to five inches in length, the male being somewhat smaller and slimmer. Both sexes possess wings, but these are rarely used. In general mantids move but little unless hungry or disturbed, though they are able to run at a considerable speed. They are positively phototropic though not markedly so, and are negatively geotropic, usually hanging upside down from the top of a container. They are entirely carnivorous, the food consisting of living insects which are captured with the modified first pair of legs and torn to pieces by the powerful mandibles. Unfortunately, the adults are cannibalistic, and must be kept in separate containers. Almost alone among insects the mantis is able to move the head in any direction. The eyes are large and vision relatively acute, and three different types of response to moving objects have been detected. Also there are a number of complex cleaning and copulatory reflexes in addition to simpler segmental avoiding reflexes, all of which make the mantis valuable material for observation and experimentation on insect behavior. Further details can not be given here, and reference should be made to papers by Binet[1] and Roeder.[2]

Mantis religiosa belongs to the order Orthoptera, and anatomically the nervous system is of a generalized insect type. The ventral ganglia are widely separated

[1] From the Department of Medical Zoology and University Hospital of the School of Tropical Medicine of the University of Puerto Rico under the auspices of Columbia University.

[2] R. M. Suárez, *P. R. Jour. Pub. Health and Trop. Med.*, 8: 299, 1933.

[3] C. P. Rhoads, W. B. Castle, G. C. Payne and H. A. Lawson, *Medicine*, 1934, 13: 317, 1934.

[4] R. Rodríguez-Molina, *P. R. Jour. Pub. Health and Trop. Med.*, 11: 49, 1935.

[5] R. Rodríguez-Molina and Juan A. Pons: Unpublished observations.

[1] L. Binet, "La Vie de la Manté religieuse," Vigot Freres, Paris, 1931.

[2] K. D. Roeder, *Biol. Bull.*, 69, p. 203, 1935.

and the paired connectives are separate. The supra-esophageal ganglia are small, with the exception of the huge optic ganglia. The simple gross structure of the nervous system simplifies operatic procedures, though unfortunately there is very little information on its histological structure.

The method of raising practiced here is somewhat similar to that mentioned by Przibram[3] who worked with *Sphodromantis bioculata,* a different species. The egg cases, containing 150 to 200 eggs, can be obtained during the winter months for a small sum from any of the larger supply houses. They should be suspended by a thread in a 16-ounce wide-mouthed bottle, which is closed with a piece of bolting cloth secured by a rubber band. A hole about half an inch in diameter should be cut in the cloth and plugged with cotton. This is to allow for the introduction of food. The eggs should be kept at a temperature of 25° to 30° C., and a 50 to 70 per cent. humidity, and should be inspected daily. Under these conditions the eggs usually hatch in three weeks. Previous to hatching a large continuous supply of wild type Drosophila should be on hand. In this laboratory the Drosophila are raised in quart bottles in the same incubator with the mantids. At least one quart bottle of Drosophila culture for every five mantids should be allowed. It is important to have a constant supply of flies, as the young mantids hatch with no food reserves and quickly starve. They usually refuse food for the first 12 to 24 hours after hatching, and a number will die. During this first day the most viable of the young nymphs should be selected and transferred with a camel's-hair brush into a 16-ounce bottle covered with cloth, as mentioned above. A little sand and a few twigs should be placed in the bottles to give the insects a foothold and prevent them crowding in one part of the bottle. Not more than 10 to 15 nymphs should be placed in one bottle. The bottles containing the mantids are then placed in an incubator at 25° to 30° C., which should be illuminated artificially or by daylight. This is important, since mantids catch their prey entirely by sight and the acuity of vision is greater in higher light intensities. They should also be lightly sprayed with water from an atomizer once a day, though too much water may drown them in the first instar. During the first day a number of living adult Drosophila should be introduced. This is simply done by holding an eight-ounce wide-mouthed bottle over the quart bottle containing the Drosophila culture. When the flies have passed into it, it is removed and held over the hole in the jar containing the mantids. If it is tapped lightly the flies will fall through the hole in the cloth, and the cotton stopper can be replaced. The flies will soon be captured and eaten, only the wings and harder portions being discarded.

After a week to ten days the mantids will moult for the first time, and care should be taken to disturb them as little as possible at this time. Since they do not eat for a day before and a day after moulting the food can also be reduced during this period. It takes nine to ten weeks at 25° to 30° C. for them to reach full size and sexual maturity, and during this period they will moult seven times. Drosophila or aphids make ideal food for mantids during the first three instars, but as they increase in size they require larger food. Any insect which is not strongly negative to light is suitable, and flies of all kinds, grasshoppers, moths, caterpillars and cockroaches have all been employed. Insects larger than the mantids will not usually be attacked and should not be presented. During the winter months living insects are more difficult to obtain, but meal worm larvae, cockroaches and flour moths can usually be obtained from neighboring factories and warehouses. On several occasions, when the food supply has failed, the mantids have been kept alive by feeding them by hand with meal worm larvae or even small pieces of frog liver. The food is held to the mouth of the mantis so that the juice touches the maxillae; it will then be grabbed and eaten. This is obviously a laborious process, and should only be resorted to when nothing else can be obtained.

As already mentioned, the mantids are cannibalistic, but this trait is not common until they become half grown, unless they are underfed or overcrowded. By the fifth instar they should be further segregated until there are only one or two mantids to a container. The adults should be kept singly in battery jars or other suitable container and should be provided with twigs to serve as a foothold.

In the writer's experience the raising of *Mantis religiosa* in captivity presents little difficulty, the presence of an observer and other artificial conditions interfering with their normal habits, mating, etc., to an inappreciable extent. The only difficulties likely to be encountered are in the provision of a continuous supply of living food. Though this can be easily overcome during the summer months, careful planning of food supplies during the winter will result in a good percentage of perfect mature insects at any time of year.

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[3] H. Przibram, *Blätter für Aquarien und Terrarienkunde,* 42, 669, 1909.

DECALCIFICATION AS A METHOD OF PREPARATION OF GROSS ANATOMICAL MATERIAL

IN an elective course in fetal anatomy, which follows the regular dissection course, the fetuses were dissected for some years using the method described by Scam-