

## A METHOD OF REARING CHIGGER MITES (ACARINA, TROMBICULINAE)<sup>1</sup>

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Although chiggers are severe pests in many regions of the world and are important vectors of disease in a large area of the Far East, satisfactory rearing methods for these mites have not been found. Rearing is peculiarly important for disease transmission studies with chiggers, since an individual mite feeds on a vertebrate host but once during its entire life and in but one stage, the larva. The disease organisms must, therefore, pass from the larva of one generation through all successive stages, including the egg, to the larva of the next generation. While there has not yet been achieved the goal of carrying through the cycle from larva to larva without serious mortality, the method described below may serve as a basis for the development of a satisfactory technique. In its present form, however, the method has been of great value in studying all stages of the life cycle and in obtaining the taxonomically important nymphs and adults from larval chiggers.

The studies upon which this paper is based were carried on with a common species which infests man in Panama, *Eutrombicula batatas* (Linnaeus).<sup>3</sup>

Evidence now being accumulated indicates that certain other species, for example, *Trombicula velascoi* Boshell and Kerr, may be reared in the same manner.

Since domestic chickens are an important and convenient host of *E. batatas*, they have been used as hosts for the chigger larvae in most of these studies. Fully engorged larvae can be obtained in large numbers and in good condition by placing a naturally infested chicken in a cage, the bottom of which is made of coarse (one-half inch) wire mesh. The cage is provided with short legs and is placed in a large tray filled with water (Fig. 2). As the engorged larvae fall from the chicken they pass through the wire mesh and land on the water, floating helplessly on the surface. It is desirable to have the water at least one inch deep so that the feces of the chicken will sink below the surface. The water in the tray is changed after each collection of the chigger larvae. Food and water for the chicken are provided in very small containers in order to interrupt the fall of as few mites as possible, and rice or white bread is used as food so that scattered particles floating on the water will not seriously interfere with finding the red larval chiggers.

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<sup>3</sup>The use of this name is discussed in a forthcoming paper. It is the same species which has sometimes been called *Acariscus hominis* (Ewing).

Twice a day until the chicken is free of chiggers (a week to 10 days) the engorged larvae are collected from the water surface onto small squares of paper. The corner of a piece of paper is dipped into the water beside a floating chigger



FIG. 1. Plaster of Paris cell covered with microscope slide, for making observations on eggs and other stages of chiggers. (Photographs, courtesy of U. S. Army Signal Corps.)

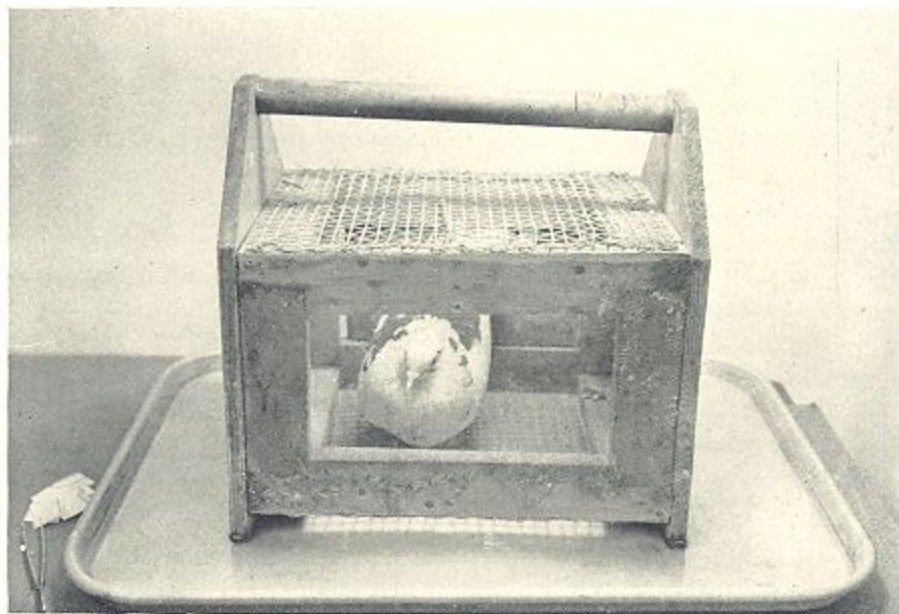


FIG. 2. Animal naturally infested with chiggers in cage standing in tray of water. Engorged larvae fall to water where they float and may be removed by means of squares of newspapers.

and on being withdrawn from the water the surface tension causes the chigger to stick to the paper. Newspaper has the proper absorptive qualities for this purpose. As the squares of paper dry the mites are released and walk about.



The moist squares of paper with the mites on them are placed in half-pint fruit jars lined on the bottom and sides with a layer of plaster of Paris one-eighth to one-fourth inch in thickness (Fig. 3). Such jars are prepared by pouring into them a rather viscous mixture of plaster of Paris and water and then turning and tilting the jars slowly until the sides and bottom are covered with a layer of uniform thickness. Continued turning is sometimes necessary until the plaster solidifies. This layer of plaster of Paris is of great importance, as it absorbs water which would otherwise condense on the glass. In unlined jars most of the engorged larvae become stuck in such water and die without trans-

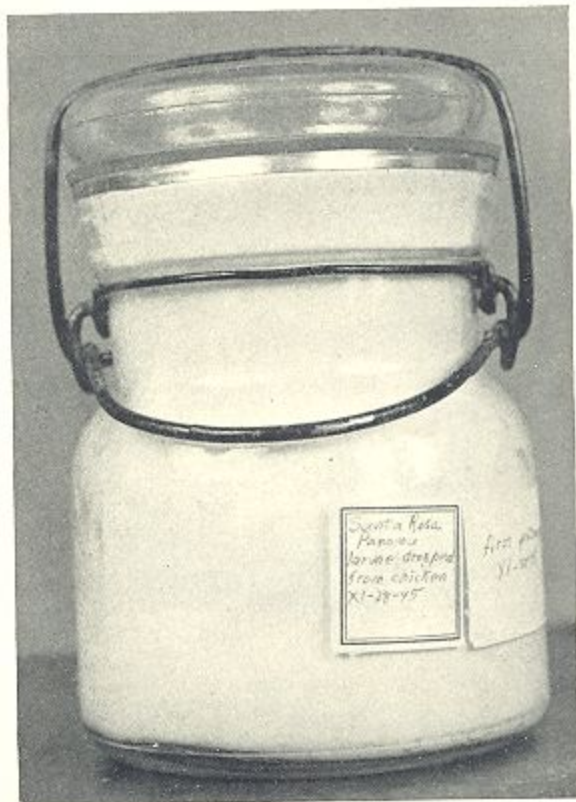


FIG. 3. Fruit jar with inner coating of plaster of Paris, for rearing engorged larvae to nymphal stage.

forming. Since engorged larvae appear to seek darkness, no difficulty is encountered with larvae crawling onto the unlined glass jar lids. The use of opaque metal lids is objectionable, however, as the larvae commonly crawl onto the lids. In order to maintain a high humidity, a few drops of water are placed in these jars whenever the paper or plaster appears dry.

It is frequently important to obtain engorged larvae for rearing from wild animals or birds which cannot practically be caged over a pan of water. This may be done by placing the dead body of an infested animal in a paper sack which is sealed with paste. After 24 hours the sack is opened and the chiggers which have left the animal are shaken into a plaster-lined jar. Others are removed by

clipping pieces of skin to which they are attached from the body of the host and placing these pieces in the jar. The latter method alone is frequently satisfactory. Of course only the fully engorged larvae survive.

Within a week or 10 days engorged larvae transform to nymphs in the plaster lined jars with very little mortality. (Longer periods are required for some species.) When all have transformed the nymphs are shaken out of the jars lined with plaster of Paris into prepared rearing jars. The most successful rearing jar so far used is a pint fruit jar with the bottom broken out and replaced by a plug of plaster of Paris about three-fourths of an inch thick (Fig. 4).



FIG. 4. Rearing jar made by replacing bottom of fruit jar with plaster of Paris. Nymphal and adult chiggers live in mixture of soil and chicken manure.

A container made by plugging one end of a lump chimney with plaster of Paris is equally satisfactory except that the top is more difficult to seal. In the jar is placed a mixture of about 5 parts moist, sterilized soil to 1 of chicken manure, as suggested by Melvin.<sup>1</sup> This mixture is then tamped down gently to form a layer about  $1\frac{1}{2}$  inches thick and the jar is ready for the nymphal chiggers. Various procedures, such as addition of growing green plants, small soil insects, sterilization to reduce mould and bacterial growth, etc., have had little effect on the growth or mortality of the nymphs.

<sup>1</sup>Melvin, Roy. Note on the culturing of chiggers. (In press.)



Best results are obtained when the top of the jar is left open. Nymphs and adults stay on or in the moist soil and do not climb out of the jars if they are open (and therefore relatively dry above the soil level). Water is added daily. Any excess passes through the plaster plug in the bottom of the jar into a petri dish in which the jar stands. Since there is a gradient in the soil from relatively dry above to very moist below, the mites are able to take up positions of favorable humidity.

Transformation to adults takes place in the soil three or more weeks after the nymphs are placed in the rearing jars.

Similar rearing jars are used for wild-caught nymphs and adults. When eggs are desired for study it is advisable to tamp the soil very firmly so that the adults cannot get beneath the surface. Then the eggs will be found on the surface. If only larvae are desired this is unimportant, since they will crawl up out of the soil upon hatching. When larvae are expected to appear in a jar the lid is clamped on with a rubber seal so they cannot escape. The petri dishes in which the jars stand are placed on squares of paper saturated with dimethylphthalate in order to kill any larvae which escape when the lids are removed for addition of water, removal of larvae, etc.

Larvae to be placed on a host animal are removed from the rearing jar by picking them up on small pieces of wet newspaper. The paper is then either fastened to a feather on the under surface of the wing of a young chicken in such position that the larvae will crawl off onto bare skin (surrounding feathers plucked if necessary) or the paper with its mites is placed in a very shallow, wide, shell vial, the open end of which is pressed closely to the skin of the host and held in position with adhesive tape. In either case as the pieces of paper dry the mites are released from the water film, and after wandering about, attach themselves to the host. Since unengorged larvae can walk on the surface of water and are not easily held by a water film, the entire operation must be performed rapidly. If the mites are released on the dense feathers of well-grown chickens a high proportion drop off without working through the feathers to the skin.

After engorgement mites are retrieved from the host in the same manner as described above for obtaining engorged larvae from naturally infested chickens. Some drop within 2 days after attachment, while others remain attached for as much as 10 days.

A small plaster of Paris cell covered with a microscope slide (held in place with a rubber band) is convenient for making special observations, for example, on eggs and later quiescent stages (Fig. 1). Such cells have the advantage that water can be added from the outside through the plaster without disturbing the contents. Nymphs and adults, however, do not appear to survive for more than a week or two in constant contact with plaster of Paris.

Using the methods here described, wild-caught females have been induced to lay eggs and from these eggs a first generation of adults has been reared. However, the mortality has been high, especially in the nymphal stage, and of the larvae hatched only about 10 percent finally yielded adults. Engorged wild-caught larvae from chickens have been reared through to adults but here again

the mortality is about 90 percent, mostly in the nymphal stage. Adults reared from wild-caught engorged larvae have in a few cases laid fertile eggs which yielded larvae, but it was not possible to rear these few larvae to adults. It is possible that the difficulty encountered in securing eggs from laboratory reared adults may be due to the disinclination of adults to mate in captivity.