

improvement in general condition and the gain in weight often begin within a few days, certainly within two weeks, and continue uninterruptedly, so far as they are dependent on digestion, as long as the breast milk is furnished in sufficient quantities. The gain in weight often exceeds that made by the wet nurse's own baby previously. Whatever function or functions have been impaired, they are evidently capable of the most rapid recovery. My experience warrants me in saying that when such an infant does not gain on the average at least an ounce a day, the fault lies with the wet nurse and not with the infant. The point which I wish to bring out clearly is that these atrophic infants are just as able to gain in weight as any normal infant when they receive a suitable food, and that breast milk is the only food that can be uniformly relied on to accomplish this result. It need hardly be emphasized that if a breast milk is of poor quality and insufficient in quantity it is no more suitable than any other poor food.

Naturally, when choosing a wet nurse, one is selected whose baby is doing well. It is not necessary that the age of your patient and the age of the wet nurse's baby should correspond. While taking breast milk, atrophic infants frequently have several more or less watery and undigested movements daily, without any evident bad results. It does not seem to interfere with the gain in weight nor with their general condition. This is peculiar to breast milk. Such dejections, if associated with other methods of feeding, would be followed by bad symptoms. It can not be denied that there are many objections to the use of a wet nurse. The serious ones, which refer to contracting diseases by the infant, can be avoided. The others must be tolerated to some extent. It must be remembered that in these cases the family of the patient are discouraged and worn out with the care of the infant, and when they see almost immediate and marked improvement they quickly become reconciled to inconveniences and are willing to put sentiment aside. Wet nurses can be controlled up to a certain point, and in this connection it is always a fatal mistake to encourage a belief by the wet nurse that she is indispensable. If she is not satisfactory, another can be procured. It is a fallacy to suppose that one woman's milk is any more suitable for a given infant than another woman's, provided both milks are good, that the quantity is sufficient, and that no mechanical hindrance exists in the one case and not in the other. If the wet nurse is made to understand that the place is hers only so long as the baby does well and she is satisfactory, it will make a difference in her behavior. I have rarely found it necessary to try more than two wet nurses in a given case, but now that I feel so certain that good results will follow this method of feeding in cases of atrophy, I should persevere until a suitable wet nurse was found, no matter how many I tried. The difficulty in making infants accustomed to the bottle take the breast is rarely serious. Persistently withholding other food for some hours will overcome their resistance. I have often found it necessary to allow the wet nurse to retain the charge of her own baby. In such cases the wet nurse's baby was fed on a mixture of cow's milk. It can not be denied that one would rather not be burdened with the wet nurse's baby, but, on the other hand, the care of her baby oftentimes reconciles her to the position and helps to occupy her time. The possibility or probability that she will nurse her own baby can be avoided without much trouble.

In my practice, when cases of atrophy are brought to me for treatment, I make it a point to express my views to the parents on the relative values of different foods. They almost always object at first to the employment of a wet nurse. Out of deference to their feeling and because it is always possible that whoever has had charge of the feeding previously has not made use of mixtures appropriate for such cases, I try mixtures of cow's milk for from two to three weeks and note the results. If the improvement is not satisfactory I recommend a wet nurse. I should omit the preliminary trial if the infant's general condition did not warrant it. Thus far I have never had occasion to regret employing a wet nurse. In many cases even a few weeks of the breast milk will produce such improvement in the weight, general condition and digestive powers of the infant that it will be able to adapt itself to cow's-milk mixtures if for any reason it becomes necessary or desirable to change.

THE ELIMINATION OF THE MOSQUITO.*

ALVAH H. DOTY, M.D.
NEW YORK CITY.

I am quite sure that the members of the American Medical Association are familiar with the general literature regarding mosquitoes, and that a detailed account of the different varieties of these insects, their anatomy, method of development and the physiologic reason why they transmit disease is unnecessary. I have chosen, therefore, to present some practical facts which have a direct bearing on the work of exterminating the mosquito.

A decided and very satisfactory change has taken place in the attitude of the public toward this subject during the past three or four years. At first, efforts to exterminate the mosquito in this country were looked on mainly from a humorous point of view, and but little co-operation was extended by the laity. The public, however, has learned that the object of this work is not only to prevent the annoyance which the bite of this insect inflicts, but also to prevent the transmission of the disease, inasmuch as it has been proved that yellow fever is transmitted by the variety of mosquito known as the *stegomyia*, and malarial fever by the *anopheles*, and that so far as we know at the present time this is the only means by which these diseases are propagated.

In the extermination of the mosquito, it is imperative that we should be familiar with certain habits or conditions of this insect, otherwise our efforts are not apt to be attended with success. We must know, first of all, that mosquitoes propagate only in water. The importance of this fact is that it gives definite information regarding the situation of breeding places. We know that the eggs deposited on the surface of the water develop into the larvæ, commonly known as the "wigglers," then into the very transient stage of the pupæ, which in appearance may be regarded as a change in the shape of the larvæ, and that these are very soon transformed into the winged insects, and that from the deposit of the eggs to the development of the winged insect only from twelve to twenty-five days elapse. The latter period, as a rule, is required for the development of the *anopheles* or malarial mosquito. So far as my

* This paper was prepared for the Section on Hygiene and Sanitary Science, but was not read, owing to the absence of the author.

own investigations show, the propagation of the mosquito is, as a rule, most active in stagnant or offensive waters, or in that which contains considerable organic matter. Two instances have recently come under my observation where broken sewer pipes discharged into ground depressions, causing collections of offensive water. In the immediate vicinity of these were pools of water which were not contaminated; i. e., collections of rain water and not of offensive fluid. In both instances it was found that the contaminated water soon became exceedingly rich in mosquito larvæ, whereas in the other pools, within two or three hundred feet distant, which contained comparatively clear water, there were very few, if any, larvæ found.

Experiments made at the New York Quarantine Station have practically corroborated this. In these experiments large superficial wooden tanks were employed, in which different kinds of water were placed; i. e., rain water, hydrant water, water in which decomposed meat and fish had been placed and water containing other offensive material. These tanks were exposed, side by side, in a place infested with mosquitoes. In all the tests, it was shown that the deposit of mosquito eggs was always greater in the tanks containing the offensive water. Experiments on a smaller scale were also made. Exposed pails and glasses containing the different kinds of water already referred to were employed and the same results were noticed, viz., the deposit of eggs was much greater in offensive water. These experiments were repeated many times with the same result and fully confirmed the conditions, which I have found in mosquito-breeding districts. The experiments to which I have just referred were made with the culex, which is the commonest type of mosquito. There is, however, a variety of the culex known as the *Culex sollicitans*, the striped-legged, Atlantic coast or salt marsh mosquito, which may be excepted from the above, inasmuch as it breeds in salt water or in salt or brackish marshes. Furthermore, the malarial mosquito, known as the anopheles, while it may be found breeding in offensive water, prefers small pools of water which are not so contaminated and which may be found in excavations containing surface water frequently having a green scum on the surface. I have found the anopheles larvæ in water contained in small ground depressions along the edge of swamps, also in unused receptacles which are found about houses. Occasionally the anopheles larvæ may be found in the same breeding pool with the culex; this, however, is not common. In a general way, it may be said that mosquitoes will breed in almost any receptacle and in the most unusual and unsuspected places, commonly in rain-water barrels, cisterns, cesspools, tin cans and other metal, glass and wooden receptacles, roof leaders, crotches of trees, etc. It is very necessary that physicians should be familiar with this fact.

It is a common belief that mosquitoes will not breed in salt marshes. My experiments show that in captivity the fact that a variety of the culex, known as the *Culex sollicitans*, or the Atlantic coast, striped-legged or salt-water mosquito, breeds in salt water or in salt marshes. My experiments show that in captivity the *Culex sollicitans* will sometimes deposit their eggs on fresh water contained in glass jars; whether or not they will do this if they are free has not yet been fully decided. It is probable that along the Atlantic coast the salt marshes in many places furnish fully 80 per cent. of the mosquitoes in these sections. Dr. John

B. Smith, State Entomologist of New Jersey, who has carefully investigated this variety of mosquito, states that it will deposit its eggs on the soft earth, in salt marshes along the sea coast, and that these eggs will remain intact for months until the swamps overflow and there is sufficient water to develop them into larvæ and subsequently into the winged insects. My experiments have partially confirmed this. I have confined the Atlantic coast or striped-legged mosquitoes in glass jars, in which was placed soft earth taken from salt marshes along the coast, and it was soon found that the eggs were deposited on this material. When salt water was added to this, after the eggs had been laid a number of days, the larvæ very promptly appeared. No proof, however, has ever been produced to show that the larvæ can be developed from these eggs without the presence of water. If the *Culex sollicitans* be confined in water to which various amounts of salt have been added or in jars containing sea water, a deposit of eggs on the surface will soon be noticed; however, I have been unable to secure this result with any but the Atlantic coast mosquito.

A general impression exists that the life of the mosquito is very short, probably a few days only. While it is true that the mosquito is not a resistant insect and easily succumbs to all sorts of influences, it is a fact that it lives indefinitely. In the hibernating stage it is known that it may live from the fall to the following spring, and during the warm weather, or in its active stage, it may live a number of weeks. It is practically impossible to arrive at any definite conclusion regarding the life cycle of the mosquito, inasmuch as experiments do not furnish satisfactory evidence, for the reason that they can not be carried out under the same conditions that naturally exist. In other words, mosquitoes may die from captivity alone, or when they are unable to select the character of food which they require. It is safe to assume, however, that if they will live a certain period in captivity, they will live equally long when they are free to go and come as they please. There have been many investigations made and published on this point, and experiments have shown that in captivity mosquitoes will live for a number of weeks. I have kept them in wire cages containing nothing but sugar water for almost two months; furthermore, mosquitoes may be kept for a long period in captivity without food or water, provided sufficient air be present. Aside from the interest in securing definite knowledge in this direction, the length of time which mosquitoes may live in captivity has an important practical bearing, as it has been claimed that yellow fever may be transmitted from one place to another through the agency of the stegomyia, or yellow fever mosquito, confined in baggage, etc. In order to secure so far as possible definite information regarding this part of the subject, I carried out the following experiments: A number of boxes which could be compared to trunks, also canvas bags, such as sailors use to contain their clothing, and other receptacles were filled with clothing, blankets, bedding, etc. Mosquitoes were collected from a horse stationed in a thickly infested mosquito district. This was done by placing glass test tubes over the mosquitoes. When a sufficient number were secured the openings of the tubes were filled with light cotton plugs. The tubes were then introduced into the receptacles already described, the cotton plugs removed and the tubes gradually withdrawn and shaken sufficiently to drive out the mosquitoes. This method was

employed in order to prevent any possible injury to the insect. In each experiment a record was kept of the number of mosquitoes in the different receptacles, and, although many experiments were made, it was found that in no instance did the mosquitoes in any receptacle live longer than thirty hours. I believe, therefore, that the treatment of baggage coming from yellow fever ports is unnecessary, provided the period of transit exceeds two days.

Considerable discussion has taken place among those who have investigated the mosquito regarding the origin of the first crop of these insects, which appear in the spring or summer of each year. As I have already stated, Dr. John B. Smith claims that the egg of the *Culex sollicitans*, or striped-legged or Atlantic coast mosquito may be deposited on the moist earth, in brackish or salt-water swamps, and that in this situation, he believes, they will remain dormant or hibernate until the following spring, when an overflow of water takes place and the eggs become active and are developed into larvæ and subsequently into the winged insects. It has also been shown that larvæ will hibernate and that during the winter they may be found in ice and after being thawed out become active. The latter phenomenon has come under my notice, but I have seen no instance in which larvæ after being frozen and thawed out have developed into winged insects. This may occur, but I am sure that it is uncommon. Although the eggs of the *Culex sollicitans*, Atlantic coast or striped-legged mosquitoes, may hibernate during the winter, and be the origin of the first crop of this variety of the mosquito in the spring or summer, I am satisfied from my own experiments that the first crop of mosquitoes which come to us each year, particularly in inland towns, or about fresh water supplies, is due to the hibernation of the winged insect. It is common experience with all who live in mosquito-infested districts frequently to find these insects in midwinter, particularly in overheated rooms, etc. It is evident that when the cold weather approaches the mosquito instinctively seeks some protected place, such as crevices in the interior of tree stumps, cellars, barns, interior of houses, etc., and, while there are probably but comparatively few which do not succumb to the cold weather, sufficient survive to perpetuate the species during the following year.

Another very much disputed point regarding the mosquito is whether or not they go far from their breeding places. While there is indisputable evidence that mosquitoes at times are found far from home, there is also the best evidence that they do not go willingly. One of the most satisfactory instances that I know of, which proves that they are found some distance from their breeding place is that furnished by the New York harbor pilots, whose boats are frequently anchored along the Jersey coast, three or four miles from land—occasionally they become suddenly infested with mosquitoes. The pilots are unanimous in their statement that when this occurs there is always a breeze from the shore. While indisputable evidence has been presented to show that mosquitoes go far from home on land, as well as at sea, there is good reason to believe that this does not commonly occur. It is the opinion of all who have carefully studied this insect that they do not willingly go far away, and I believe that we are justified in assuming that if a section of country be infested with mosquitoes a breeding place exists in the immediate vicinity. I speak emphatically in this mat-

ter, as many times after it has been positively stated that mosquitoes must have come a long distance, it has been found that breeding places existed in the neighborhood, and there is no doubt that the difference of opinion which existed on this subject is largely due to the fact that local breeding places are frequently overlooked. When it is remembered that the female mosquito will lay three or four hundred eggs at one time, and that it only requires from twelve to twenty-five days for these eggs to develop into the full-grown winged insect, it will be better understood how a small receptacle will breed a large number of mosquitoes. Therefore, before hunting for the breeding places of mosquitoes at some distance from home, we should first examine every detail of our own premises to ascertain if receptacles for the propagation of this insect can not be found.

These breeding places are often discovered in the most unsuspected locations. In connection with this and as an item of interest, I will refer to an investigation made two or three years ago. My attention was called to a number of cases of malarial fever occurring in two or three houses adjoining each other. Anopheles were found in the bedrooms of these patients during the evening. In close proximity to these houses were found numerous pools of water, and, although each one was examined with great care, no anopheles larvæ were found. The most careful inspection was made of every cistern, rain-water barrel, etc., in the neighborhood with the same result. This lent some color to the belief that the mosquito in this instance might have come from a distance. Further investigation was made, however, and in the garden of a house in the rear of those containing the cases of malarial fever, and which had been vacated for some time, was found an old cake pan almost entirely covered by long grass, and in this was found a large number of anopheles larvæ. An ordinary inspection would not have discovered this receptacle.

As a résumé of what we know at the present time, it may be said:

First, mosquitoes do not propagate without water, and, as a rule, so far as the *Culex* is concerned, the more offensive the water, the greater the propagation. Although the anopheles or malarial mosquito will propagate in offensive water, sewerage, etc., they are more apt to be found in small collections of water, about fresh water swamps or in small receptacles about the house. In large ponds or pools of fresh water, particularly those which contain small fish, which prey on the larvæ, mosquitoes of any variety are not usually propagated, but the little pockets of water along the edges of these ponds or in other places frequently act as breeding places. We also know that a variety of mosquito known as the *Culex sollicitans*, or the striped-legged, Atlantic coast or salt marsh mosquito, breeds in salt water or in salt marshes. Mosquitoes breed in cisterns, rain-water barrels and cesspools in enormous number; other receptacles about the premises, no matter how small or where they are situated, may also act as breeding places. It is about our own homes, therefore, that the examination should first be made to ascertain where the propagation of this insect is carried on.

Second, the life of the mosquito is not confined to a few days, but under various circumstances may extend over a period of weeks or months.

Third, the first crop of mosquitoes which appears in the early summer of each year, particularly in inland towns, is principally due to the deposit of eggs which

have hibernated during the winter months. These, of course, are comparatively few in number, but are sufficient for the purpose above referred to. The variety of the mosquito known as the *Culex sollicitans* is probably largely perpetuated by the hibernation of eggs, which are deposited in the soft earth, in salt marshes along the sea coast, and remain dormant during the winter; when the warm weather returns and the marshes are overflowed with water, these eggs become active and develop into larvæ; subsequently into winged insects.

Fourth, although there is conclusive evidence that mosquitoes are sometimes carried long distances from home, they do not willingly go far from their breeding places, and it may be assumed that if a section is infected with mosquitoes breeding places exist in the immediate vicinity. It is probable that an exception may be made in the case of the *Culex sollicitans*, or salt-water mosquito, which appear to go further from home than other varieties of the culex or the anopheles. There is good reason to believe, however, that they do not breed away from the salt marshes or in collections of fresh water.

Efforts to prevent the propagation of the mosquito consist in abolishing or removing receptacles which contain water. This applies to both large and small ground depressions, swamps, etc., and to portable and stationary receptacles about buildings. The scientific, practical and radical method of removing water in ground depressions is by drainage or filling in, and the use of petroleum oil in these instances can not be regarded as a substitute for this purpose and should only be used as a temporary measure. In mosquito-infested districts our first action should be to remove, so far as possible, from dwelling houses and other buildings, all sorts of metal, glass and wooden receptacles for water. Cisterns and rain-water barrels should be supplied with tight-fitting covers; by having the center of these covers constructed of wire netting sufficient air is admitted. Roof leaders should be kept properly graded; otherwise parts of them may act as breeding places for the mosquito. If ground depressions either about the premises or in the neighborhood can not be drained or filled in, petroleum oil may be used as a temporary measure. The crude petroleum is probably superior to the refined oil and should be used in the proportion of one pint of oil to a water surface of about twenty feet in diameter—even a less amount of oil may be effective. This procedure should be repeated every two weeks. The method by which the oil destroys the larvæ or wigglers is probably not by a toxic effect, but by a mechanical one. The larvæ must come to the surface of the water for air at least every two minutes. If watched carefully it will be seen that the culex, or common variety, approach the surface of the water at right angles, with the tail uppermost, the air being taken in at this end, which is extended sufficiently above the surface. The anopheles larvæ may be distinguished from the culex at this stage, inasmuch as they do not lie at right angles to the surface of the water, but parallel to it, and receive the air by projecting the head above the water instead of the tail. It is probable that the oil thrown over the surface plugs up the delicate respiratory apparatus of the larvæ and practically suffocates them. This is largely corroborated by experiments. If a small amount of petroleum oil is thrown over the surface of the water in a glass jar containing larvæ, the latter will succumb in from ten to twenty minutes; toxic agents do not kill them with such rapidity, as careful investigation has

proved. The odor of petroleum oil is either very unpleasant or injurious to the winged insect. It has frequently been noticed when petroleum has been used in swamps in large quantities that the number of mosquitoes abruptly diminishes.

In treating large bodies of water with petroleum, the ordinary garden sprinkling pot is a good and practical method of distributing it. Experiments made with permanganate of potassium, bichlorid of mercury, sulphate of copper, carbolic acid, etc., have shown that these agents are greatly inferior to petroleum for this purpose. Their action is slow, and the mosquito larvæ live in comparatively strong solutions. For instance, larvæ have remained active from one to three days in a 1/1500 solution of bichlorid of mercury. Even comparatively strong solutions of carbolic acid or permanganate of potassium do not destroy them for some time. In some very exhaustive experiments made with sulphate of copper and lime for the destruction of mosquito larvæ,¹ I found that these agents did not destroy the mosquito by a toxic effect, but slowly by clarifying the water and precipitating the organic matter which it contained, thereby removing the nourishment from the larvæ. Furthermore, it must be remembered that pools of water throughout the country may be used for drinking purposes, particularly by animals, and that the use of such agents as bichlorid of mercury, carbolic acid, etc., are, therefore, unsafe. On the other hand, the petroleum oil is cheap, practically harmless and destroys the larvæ at once, and so far as we know at the present time is superior to anything else for this purpose, provided proper drainage or filling in can not be effected.

All varieties of mosquitoes are most active after sundown. This we know not only from the annoyance which they cause us, but from the indisputable testimony presented by medical experiments with the malarial and yellow fever variety. During the day, when the mosquitoes are generally inactive, they select for their abiding place the high grass and underbrush. Therefore, this material should be removed if present about the premises in mosquito-infested districts.

The points to which I have referred in this paper constitute the bulk of what is at present really known regarding the habits of the mosquito and the means of exterminating them. Many investigations, however, are now in progress in this country, and there is good reason to believe that much valuable information will be added to our knowledge during the next year.

ANKYLOSTOMIASIS OR UNCINARIASIS.*

T. M. RUSSELL LEONARD, L.R.C.P., L.R.C.S. (Ed.)
GRENADA, BRITISH WEST INDIES.

This disease, an endemic anemia caused by the parasite. *Ankylostoma duodenale* or *Uncinaria duodenalis* and *Uncinaria americana* (Stiles), is a dangerous one both to the individual and to the community in general, leading as it does in individual cases to degeneration of important organs, resulting probably in death and to widespread infection and deterioration among the community in general.

The parasite is now too well known to need a full description; in Grenada, B. W. I., the large majority of cases show the old world parasite, viz., *A. duodenale*

1. Medical Record, Jan. 21, 1905.

* Read in the Section on Stomatology of the American Medical Association, at the Fifty-sixth Annual Session, July, 1905.