Insects That Carry Disease*

Insidious and Elusive Foes of Man

By Charles Dury

THE newspapers contain frequent warnings to housekeepers to be sure and "swat the first flies." They don't tell what kind of flies to swat, for, be it remembered, there are flies and flies; something like 10,000 species in America, north of Mexico. It is to be presumed the papers refer to the "house-fly," *Musca domestica*, or the "stable-fly," *Stomoxys calcitrans*, both of which are legitimate game to "swat." Not that swatting in this way will do much good; but people do so love to swat something; it is an ancestral trait. It would be much better to "swat" the breeding-places of these two species. In that way something can be accomplished. There are some small tachine flies, that so resemble house and stable flies in appearance superficially, that it takes an expert to distinguish between them. Yet, in habits they are absolutely different. The tachina flies devote their lives to the destruction of various lepidopterous and other larvæ, many of them the most injurious kinds. They destroy these larvæ by depositing their eggs on the body of the larva. In destroying the breeding-places of house and stable flies, none of the tachina flies would be harmed, as they do not frequent such places. I mention these facts to show that only a very limited number of species of flies are injurious, and that many other species are the most valuable of living creatures.

According to some of the newspapers, the house-fly's sole purpose in life is to gather up an assortment of disease germs, and deposit them on our food, malignant typhoid fever being their specialty, and they doubtless deserve the reputation they have so recently acquired.

In former years, in the discussion of the habits and merits of the house-fly, I have heard it stated that they were useful as scavengers. At that time it was not even suspected that they had played so important a part as disease carriers. After many years' study of insects under normal conditions, I have failed to find any benefit or value in the house-fly, aside from its being the faithful ally of the doctor and undertaker.

The house-fly does not bite, its proboscis being soft and fleshy. It does not require a biting insect to infect one with bacterial diseases, as it does in the case of malaria and yellow fever, whose parasitic organisms are protozoans, which are conveyed and introduced into the blood of a non-infected person by the bite of certain mosquitoes. The automobile has done much to help in the control of the house-fly. While it is liable to slip up on you with its "gum-shoes," and knock you before you can escape, yet it has largely displaced the horse, and, with the passing of the horse, the manure-pile, the most prolific breeding-place of flies, is also gone. Warmth and moisture are two requisites in the rapid breeding of house-flies. The stable-fly breeds in similar filth with the house-fly; but, unlike the house-fly, it is a savage biter. I have heard persons exclaim: "My! how the flies bite; it must be going to rain!" thinking they had been bitten by a house-fly, as the two species look so very much alike.

The stable-fly is suspected of being a carrier of infantile paralysis. The investigations of Brues and Rosenau point strongly in that direction. The stable-fly is, therefore, a very dangerous and undesirable invader of the home.

Another small fly that should be looked on with suspicion is the little *Drosophila*, or "fruit-fly." It breeds in human and other excrement, and, in country places, may walk over the excreta of a typhoid patient, and then fly directly to and alight on the fruits and vegetables, leaving bacteria wherever it goes. It is particularly attracted to over-ripe fruits, and those that are beginning to ferment and decay. In clean and well-sewered cities, where the excreta of the sick are well disinfected and destroyed, the danger of infection by house-flies is reduced to a minimum. Consumptives who spit bacilli-laden sputum in the streets are a menace. The house-fly is attracted instantly to such matter.

If flies invade the home, they can be driven out by making the room dark, leaving one opening through which light can enter. The flies will fly to the light and exit. This is better than

swatting or mashing them, and knocking the bacteria off into the room, to be breathed or eaten by the inmates. See that the fly-screens are tightly fitted, and in place not later than May 1st, where they should remain until November. With the house-fly an ounce of prevention is worth many pounds of cure.

SPOTTED FEVER.—TICK DERMACENTOR VENUSTUS.

A young man from Cincinnati wished to locate in the West, and made a trip of inspection, visiting Montana, Washington, Oregon, California, and New Mexico. He was very much impressed with the Bitter Root Valley, Montana. But he was warned by disinterested persons that there was a deadly disease there that very frequently proved fatal, and that the disease was caused by the bite of a tick, *Dermacentor venustus*. In view of this alarming condition, and notwithstanding the fertile and climatic advantages of the valley, he did not invest any money nor locate there. The mortality from this disease, called spotted fever, is given at 70 per cent. In 400 cases reported, 280 died.

The following facts should be noted:

1. Ticks infested with this disease are found in nature.

2. Adult ticks are able to acquire the disease by biting an infected animal, and to transmit it through the egg stage to the succeeding generation.

3. That certain mammals, including man, are susceptible to spotted fever.

4. To be able to develop eggs, the female must first become engorged with blood of some mammal. These facts have been abundantly proven by a series of experiments. While it is true that in the immature stage the tick feeds on the blood of the smaller wild mammals, in the adult stage they almost invariably feed on the large domestic mammals. Messrs. Hunter and Bishopp have shown that if the cattle are dipped in a solution of sodium carbonate, arsenic tri-oxide, pine-tar and water for three successive years, these ticks can be exterminated in this valley, and, in addition, it is desirable to exterminate as far as possible the smaller rodents and other mammals, which are a serious pest to agriculture, aside from the fact that they at times harbor larval ticks.

In Middle Park, Col., the chipmunks were so destructive at the time I made a visit there that nothing could be grown. An old ranchman told me that while he was planting a row of beans, the ground-squirrels were digging up his seeds while he was at the other end of the row, and this abundance of these animals prevails over much of the West.

To the biologist, the most interesting feature of this problem is: Why is this disease so deadly in the Bitter Root Valley, and so mild comparatively in other localities where the fever tick occurs, and what is the danger and likelihood of the virulent form of the disease spreading to other localities by the moving of cattle that might carry the ticks with them? It has been estimated that the disease can be eradicated by arsenating the cattle, as mentioned above, and at a cost of \$23,692 for the Bitter Root Valley, and specifications are given by Messrs. Hunter and Bishopp how this can be done.

YELLOW FEVER AND MALARIAL MOSQUITOES.

Some years ago a river steamboat, plying on the river from New Orleans to points as far up the Ohio River as Cincinnati and above, left New Orleans during one of the frequently recurring epidemics of yellow fever that had for years scourged that city. On the way up, and when near this city, come cases of yellow fever developed. The health authorities would not allow the boat to land, and compelled it to go up the river, fearing contact with these patients, and a spread of the disease here. There was a considerable scare at the time. The condition of the passengers and crew of the boat was most distressing. They were not allowed to land anywhere, and could not secure necessary articles for their use. At that time there was a total misconception of the method by which this fearful disease was transmitted from one person to another. It is perhaps well known to all medical men how the discovery was made that this disease could only be transmitted by the bite of mosquitoes of one species, *Edes calopus*, and that this mosquito must first be inoculated by biting someone afflicted

with the disease. You no doubt remember the work that was done in Cuba and elsewhere to prove these conclusions. How these most courageous and devoted students worked at the risk of their lives, and, in some cases, died in the work. How they used the garments and slept under bedding that had been taken from patients who had died of the disease in its most malignant form, to prove that the disease could not be contracted by contact. For several years the entomologists of the U. S. Department of Agriculture have been making a survey of the more southern and central parts of the United States to ascertain the exact geographical distribution of the yellow-fever mosquito. In 1905 an agent of the department called to see me, and examine the collections of diptera I had made here, to see if this mosquito was among them; but it was not. He was unable to find the species here. The nearest points to Cincinnati that he did find them were Frankfort and Louisville, Ky. He urged me to continue the search at a later date, so as to cover a greater range of territory and seasonal conditions. I started at Anderson's Ferry to the west of the city and investigated numerous points around the city as far east as Linwood. I made a careful search of the favorable places along the Ohio River, such as blacksmiths' shops where there were water-tubs seldom used, the cellars of fruit-houses where bunches of bananas were hanging, the holds of river steamboats, etc., but not one specimen could I find. Since then I have carried on the search, and though hundreds of mosquitoes were captured and examined, a number of species among them, not one *Edes calopus* was there. While this is not conclusive, it would rather indicate that Cincinnati is not within the limits of distribution of this species. In this mosquito search I found malarial mosquitoes, *Anopheles punctipennis*, in great abundance; this is a rather large, dark-colored mosquito, with the wings strongly maculate with blackish spots. This mosquito again calls to mind conditions that prevailed here years ago when malaria, then called "chills and fever," "ague," or "shakes," was a common disease around Cincinnati and across the river in Kentucky. Many people had it every fall, so they rather became used to it. The quinine bottle stood on the mantelpiece with a spoon alongside. It went without saying, "Help yourself if you've got the shakes," and wash it down with a little corn whisky.

When we got our first fly-screens, nearly thirty years ago, I was peevish, because it prevented my getting the fine specimens of insects that came into the house, attracted by the light in the evenings. My companion in disappointment was the family cat, who was my competitor in securing the choice beetles that were then shut out.

As is well known, the organisms conveyed by anopheles, which are the germs of malaria, belong to the group of minute animals known as *protozoa*, and the germ of yellow fever and spotted fever also belong to the same class of parasitic organism. The malarial germ must first pass through the body of the mosquito before it reaches its complete development. The bite of anopheles is no worse than the bite of any other harmless mosquito, unless it is infected with germs secured from a malarial person. While I have frequently been bitten by this mosquito, I have never had malaria; either they were not infected, or I was not in a receptive condition.

In the American Museum of Natural History in New York there is an enlarged series of models which show anopheles and the malarial germs in a most beautiful manner, and one can see at a glance how the thing is done. The study of the lower forms of animal life is filled with such fascinating interest, and is of such importance, that one wonders why it is so neglected, and why so few otherwise well-informed persons are unable to distinguish their friends from their foes, even in the insect world.

CHIGGERS OR TROMBIDIUM—LEPTUS IRRITANS.

Forty years ago I never met with this pest in the vicinity of Cincinnati, although at that time I was doing a good deal of field work in collecting insects and other objects of natural history. In sweeping weeds and grasses, and beating the foliage of trees into net and umbrella,

*Read before the Science Club, University of Cincinnati.

I must certainly have encountered them if they had been here. About twelve years ago I first began to notice their presence in certain localities. Now they have spread nearly everywhere, and are particularly abundant in briary thickets. This is a serious calamity. How the thing has been introduced, or if always present, what has caused it to spread and become such a pest, would be interesting to know. They are excessively minute, being scarcely visible to the unassisted eye. Their life history has not been completely worked out, but it is supposed they are the larval form of one of the mites, hence the name sometimes given them of "harvest mite." Their method of attack is as follows: They crawl out on the tips of grasses or leaves, and remain in wait for some warm-blooded mammal to pass by, when they reach out with their forelegs and attach themselves to cloth-

ing or hair. If it is a man on to which they have secured a foothold, they crawl under the clothing and get to the skin, where they enter the sweat-pores, setting up a severe irritation with intense itching. The skin is red around the point attacked. In a few days a small pustule forms, and the dead mite is expelled by the discharge of the pustule. The supposition is that the irritating fluid of the mite is acid, hence the selection of some alkaline remedy. Ammonia in some form is often used. Soda also has a good effect. In the South they use a piece of fat salt bacon, which is rubbed over the part affected. Where there is much spreading of the inflammation, an antiseptic treatment is good, such as borax, peroxide of hydrogen, etc. But prevention, that most potent of all remedies, is to be recommended. A friend in New Jersey tells me before going out he wets his skin

with a solution of washing-soda and allows it to dry on the skin. Another precaution is to use some strong-smelling essence, such as pennyroyal or peppermint, which acts as a repellent as long as the odor lasts. This is to be applied to clothing around the ankles, waist, and neck, just before exposure. Naphthalene is also a good repellent. These mites are a six-legged creature in the "shigger" stage; but when they reach maturity they acquire an additional pair of legs.

This species is not the "chigger" or "chigoe" of the tropical parts of South America. That is a "sand flea," *Sarcopsylla penetrans*, whose female burrows beneath the skin, generally under the toenail, where the insect deposits her eggs. This flea must be taken out, or fatal results may follow. The great desideratum here is to study the life of this mite, and identify the adult form.

An Aviation Map of the World and Marks for Aviators

Based on the International World Map

WITH the daily advances in the science of aviation and the many demonstrations of its practicability, we are coming closer and closer to the vital problem of finding a suitable method by which a pilot of the air may locate his position and either verify his course or lay out a new one. This problem has been ably dealt with by the French who have planned a system on which Mr. Ch. Lallemand has reported. There follows here an abstract of this article from the appendix of the annual report of the Smithsonian Institution.

In order to attain the required object, and to preserve the necessary clearness, an air map must show only the details required by aviators, both for finding their way and for landing. First, the characteristic geographical features of the earth are to be considered, such as, railroad lines, roads, rivers, forests, groves of trees, large cultivated areas, large towns with their outlines and principal streets, high chimneys and towers, and all objects liable to attract the attention of the pilot from a distance. Second, the less noticeable but dangerous points are to be reproduced, such as pits, hedges, canals, electric power lines, and other objects liable to impede a landing; besides gasometers, aerodromes and sheds where refuge and assistance may be had.

At Mr. Lallemand's suggestion it was decided that the new map should be a subdivision of the recently adopted "International Map of the World," on a scale of 1 to 1,000,000. The world map to furnish an index diagram for the fitting together of the sheets of the air map.

The world map is designed with the meter as the unit of length, and the meridian of Greenwich as the origin of the longitudes. The sheets are limited by meridians drawn out at successive intervals of 6 degrees, extending from Greenwich, and by parallels traced out at successive intervals of 4 degrees, reckoning from the equator.

The meridian sectors, from longitude 180 degrees east or west of Greenwich, are given numbers from 1 to 60, increasing in an easterly direction. The zones, extending from the equator, to 88 degrees latitude, are given letters, from A to V, preceded by the words north or south. The polar areas are lettered Z. Each sheet bears the name of the locality or most important geographical feature of the territory represented, and the number of the sector and the letter of the zone crossing each other on the sheet in question. For example, the sheet on which Paris is located is marked "North M. 31."

For each sheet, the corresponding part of the earth is represented by a modified polyconic projection constructed on its central meridian. The meridians are straight lines, and the parallels, arcs of circles, the centers of which lie on the prolongation of the central meridian.

On the other hand, the sheets of the air map will be limited by meridians and parallels at successive intervals of 1 degree of longitude and 1 degree of latitude, reckoned from the same origins as for the world map. Twenty-four sheets of this map will cover the same area as the corresponding sheet of the world map on the scale of 1 to 1,000,000. As this scale is five times as large, each of these sheets will have approximately the same dimensions as the corresponding sheet of the 1 to 1,000,000 map.

It is customary to distinguish between longitudes east and west of the initial meridian, and between latitudes north and south of the equator. The nomenclature of the latitude and the longitude therefore changes as one passes across either of these lines of origin. In other words, degrees of longitude increase to the right or

left from the initial meridian, and degrees of latitude increase both north and south from the equator.

In order to overcome the disadvantage caused by this method it has been decided to number the longitudes from 0 degree to 360 degrees, in an easterly direction commencing from longitude 180 degrees east or west of Greenwich, and to substitute, for latitudes, polar

Each sheet of the air map will bear the name of the most important locality on the area covered by it, and be numbered by the co-ordinates of its southwestern corner. This number shows the number of degrees of longitude and south polar distance in the co-ordinates of any point in the sheet, and in order to obtain the complete co-ordinates of any given point, it will be sufficient to add to these figures the tenths of degrees or minutes, obtained from the marginal scales.

The "air map" will be constructed on the same modified polyconic projection as that used for the world map. Each sheet being 56 centimeters, or 22 inches high, and from 41 to 34 centimeters broad.

In this system, the distortion of the air map would be 36 times smaller than that of the world map, since a sheet of the air map covers only one degree of longitude, instead of 6 degrees. As the scale of the air map is 5 times as large, the errors from this source are reduced to one seventh of those in the world map.

The index map may be used for ascertaining distance to be traversed, and could be used for traveling. A straight line having been laid out between two points, Bourges (dot in 72, Fig. 1) and Pau (dot in 39, Fig. 1), for example, the pilot can see the general line of his route and the sections of the map it crosses. If the pilot saw on the ground beneath him a mark like Fig. 2, but with the figures 5 and 0 on either side and the black dot in the position of the town of Angoulême as it appeared on sheet 50 of the index map (Fig. 1), he would at once conclude that he had deviated from his course to the right, and after an estimation would incline 25 or 30 degrees to the left. Although this map might serve for a trip, a detailed map would be necessary for landing.

As has been mentioned, each mark on the ground should show the approximate longitude and polar distance of its position. The sign adopted by the French Committee consists of a half rectangle (Fig. 2) representing the half sheet of the air map in which the mark lies. Within the frame the black dot indicates the position on the sheet of the mark on the ground. Reading from the south, two large figures are marked on either side of the rectangle, the left one indicating the last digit in the degrees of polar distance, and the right one the last digit in the degrees of the longitude. (See Fig. 2.)

The combination of these two figures, forming a number easy to read and remember, will be sufficient to define the number of the corresponding sheet of the map, and to give the rough co-ordinates of the mark itself.

Owing to the absence of the digits showing the hundreds and tens of degrees of longitude and polar distance, any two marks, which are 10 degrees, or a multiple of 10 degrees apart, will have the same number. This advantage will not be of great importance, however, for an aviator, to confuse two such marks, would mean that he would make an error of 10 degrees of either longitude or latitude. In latitudes between 40 degrees and 50 degrees, this error would amount to 1,100 kilometers (683.5 miles) of latitude, or from 700-800 kilometers (435-497 miles) of longitude, a very great distance.

The initiative taken by France in producing an air map and establishing aeronautical marks will very probably be adopted by the other countries, but in such a case an international agreement would be necessary to make the system conventional. This plan was augmented in May, 1911, by the Cartographical Committee of the International Aeronautical Federation, which met in Brussels and adopted in principle the system offered by the French.

Fig. 1.—Index diagram showing the sheet lines of the Air Map for France.

— Limits of the sheets of the Air Map. — Limits of the sheets of the World Map. 39...72 Numbers of the sheets PAU...BOURGES, etc. 30, 31, 32 Numbers of the sectors of the World Map. K, L, M Letters of Zones of the World Map. ● Chief towns of departments. Itinerary from Bourges to Pau.

distances measured from the South Pole, and reading from 0 degree to 180 degrees. This is done in order that in the northern hemisphere, where most of the inhabited countries are situated, the numbers may increase as usual from the equator northward. Moreover, in the northern hemisphere, the units of degrees would be the same for a south polar distance as for the corresponding latitude. The units of the longitude adopted will be the same, between 180 degrees and 360 degrees,

Fig. 2.—Aeronautical mark.

Erected on the roof of a building in the environs of Pau, which occupies, in the lower half of sheet 39, the relative position represented by the large dot, both on the above frame and on the index diagram (Fig. 1). The co-ordinates of the SW. corner of the sheet 39 are: 133 degrees south polar distance and 179 degrees new longitude E. reckoned from meridian 180 degrees E. or W. of Greenwich (that is, 43 degrees latitude N. and 1 degree longitude W. of Greenwich).

as they are now for longitudes east of Greenwich. The degrees, in the case of south polar distances, will be increased by 90 units, and, in the case of longitudes east of Greenwich, by 180 units.