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Insects and Man

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would write us indicating the region in which you are interested, we would be glad to send you a list of such stations. The General Biological Supply House, Chicago, Illinois, also publishes a bulletin listing such stations.

INSECTS AND MAN

Biology

Because of their relationship to dangerous human parasites, insects have been responsible for the death of more people than all other animals put together. Confirmation of this astounding statement can be seen in the close relationship between houseflies and typhoid fever, between rat fleas and plague, tsetse flies and sleeping sickness, and that between mosquitoes and yellow fever and malaria. This last-named disease killed five millions of people in India alone in 1897, and it is the purpose of this article—the last in the series under the caption above —to show the nexus between mosquitoes and malaria, one of the great plagues of mankind.

The word malaria means, literally, bad air, and for centuries, the disease being associated as it was and is with low grounds and swampy conditions was supposed to be due to the miasmatic effluvia from foul water and decaying vegetable matter. But in 1880 Laveran discovered and described the malaria-producing organism, a minute, one-celled amoeba-like animal living in the red blood corpuscles of man. Some species of the malarial parasite attack birds and certain other animals.

Immediately upon their entrance into the blood stream, the malarial parasites bore into the red-blood-corpuscles and grow there rapidly, eating and destroying the corpuscles as they develop. During development they produce a characteristic black pigment and this discharged through the urine gives rise to the term, black-water fever. At maturity, the parasite breaks into a number of spores, the dead corpuscle ruptures, the released spores each invade a new corpuscle, and the cycle begins over again. This is of course, nothing but ordinary asexual reproduction.

By examining the blood of malarial patients, it had long been known that certain of the parasites never transformed into spores. Moreover, when blood was drawn from a malarial patient, some of the non-sporulating forms were seen to break up into a number of minute, swift-moving filaments; these were later shown to be male gametes or spermatozoa, and others of the non-sporulating forms to be eggs. Although the gametes were thus demonstrated, it was well known that they were never produced inside the blood stream. What could be the purpose of these sexual forms, since in the blood, the parasite always propagated asexually?

It occurred to Dr. Patrick Manson that these sexual forms could mean only one thing, namely, that the parasite had a sexual reproduction stage which took place outside man's body, probably in the stomach of some suctorial insect.

Acting on Dr. Manson's suggestion as to the probable relation of the sexual phase of malaria to insects, Major Ross of the British Army, went to India in 1895 to study the problem. Ross was not a zoologist and knew very little about insects, but his tremendous courage and enthusiasm more than made up for his deficiencies. His methods were simple. Since mosquitoes are the insects most abundant in swampy, malarial districts. Ross naturally chose this insect as the presumptive agent of transmission of the disease. He allowed mosquitoes to bite badly infected patients, and then after varying periods of incubation, made minute dissections of each insect to see what happened to the parasites when taken into the stomach.

While the method was simple, it was laborious; it required two or more hours to examine each insect organ by organ, or in Ross' somewhat exaggerated statement, "cell by cell." For two and one-half years his labors were fruitless, and Ross grew discouraged. He began to wonder if after all Manson had not been mistaken.

He went to another part of India but with no better results, except that he found a new kind of spotted winged mosquitoes. Up to this

time, Ross had been working with mosquitoes of the genus Culex, and this new spotted-winged variety proved the key to his difficulties.

A native had brought him a vial of mosquito larvae and from these larvae had developed a number of spotted-winged adults. Ross decided to dissect them. The first six showed nothing, but in the seventh, to his great joy and astonishment, he found a number of large swellings on the outer wall of the stomach. When examined, these swellings proved to be fertilized eggs of the malarial parasites, and each contained some of the black pigment mentioned above.

About this time the plague scare in India made it practically impossible for him to procure human material to work with, so he turned his attention to the relation of malaria to birds. As said above, certain birds, notably sparrows, are highly susceptible to malaria, and using the same methods, Ross soon had the secret of the relation of mosquitoes to malaria .

When malaria-infested blood is drawn into the stomach of a mosquito, the sexual phase, that is, fertilization occurs in a few minutes. The fertilized egg then bores into the wall of the mosquito's stomach where the further development into spores occurs. These spores are then discharged into the body cavity of the insect from which they enter the salivary glands of the mosquito and are then discharged into the wound when the mosquito bites its victim. These spores then develop into the true amoeba-like parasites, enter red-blooded corpuscles, and thus initiate the malaria symptoms.

Ross' failure at first was due to his use of the wrong kind of mosquitoes. Mosquitoes of the genus Culex do not carry the species of malaria which affects man; the spotted-winged variety—those of the genus Anopheles—alone are to blame.

As soon as the definite relationship between mosquitoes and malaria was established it became relatively easy to control the disease. The main factors in control are, of course, obvious enough. Destroy the breeding places of mosquitoes and avoid being bitten by mosquitoes of the genus Anopheles. Mosquitoes lay eggs in water and the aquatic larvae are easily destroyed by pouring a thin film of oil over water containing them. The malarial mosquitoes are largely nocturnal in habit and all homes in malarial regions should be carefully screened.

Malaria is one of the few diseases for which there is an almost certain specific,—namely quinine.

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CARE OF LABORATORY EQUIPMENT

"We have good equipment, but no place to keep it arranged in order so that we have quick access to it." The above statement describes the condition under which some high school departments operate. A condition of this kind places extra work upon the teacher and uses valuable time that is needed in class room instruction.

Valuable equipment deserves a place where it can be properly stored, quickly found, and easily checked out to the students when needed. A store room should be provided. Perhaps, a vacant room, a hallway, or an unused corner of the laboratory might be remodeled by the pupils in the manual training department or by some member of the science classes. When this is done, the next procedure is to plan the arrangement of the shelves for the apparatus, chemicals, and other laboratory necessities. The shelves should be large enough for the storage of the different equipment for the maximum sized class. Next number these shelves in large numerals. Then, secure a record book and list the equipment and supplies alphabetically with the number of the shelf where each article is found. Clean up the equipment and transfer it to the new store room.

Once a year an inventory should be taken and the bulk of the equipment to replace that used up or broken may be ordered at this time. Record cards, desk equipment sheets, and other essential forms for the dispenser's and instructor's use may be prepared by students of the class on the mimeograph machine or