THE WAYS IN WHICH ARTHROPODS MAY AFFECT THE HEALTH OF MAN

When we consider the ways in which insects and their allies may affect the health of man, we find that we may treat them under three main groups:

A. They may be directly poisonous. Such as, are the scorpions, certain spiders and mites, some of the predaceous bugs, and stinging insects. Even such forms as the mosquito deserve some consideration from this viewpoint.

B. They may be parasitic, living more or less permanently on or in the body and deriving their sustenance from it.

Of the parasitic arthropods we may distinguish, first, the *true parasites*, those which have adopted and become confirmed in the parasitic habit. Such are the itch mites, the lice, fleas, and the majority of the forms to be considered as parasitic.

In addition to these, we may distinguish a group of *accidental*, or *facultative parasites*, species which are normally free-living, feeding on decaying substances, but which when accidentally introduced into the alimentary canal or other cavities of man, may exist there for a greater or less period. For example, certain fly larvae, or maggots, normally feeding in putrefying meat, have been known to occur as accidental or facultative parasites in the stomach of man.

C. Finally, and most important, arthropods may be transmitters and disseminators of disease. In this capacity they may function in one of three ways; as *simple carriers*, as *direct inoculators*, or as *essential hosts* of disease germs.

As simple carriers, they may, in a wholly incidental manner, transport from the diseased to the healthy, or from filth to food, pathogenic germs which cling to their bodies or appendages. Such, for instance, is the relation of the house-fly to the dissemination of typhoid.

As direct inoculators, biting or piercing species may take up from a diseased man or animal, germs which, clinging to the mouth parts, are inoculated directly into the blood of the insect's next victim. It thus that horse-flies may occasionally transmit anthrax. Similarly, species of spiders and other forms which are ordinarily perfectly harmless accidentally convey and inoculate pyogenic bacteria.

It is as essential hosts of disease germs that arthropods play their most important role. In such cases an essential part of the life cycle of the pathogenic organism is undergone in the insect. In other words, without the arthropod host the disease-producing organism cannot complete its development. As illustrations may be cited the relation of the Anopheles mosquito to the malarial parasite, and the relation of the cattle tick to Texas fever.

A little consideration will show that this is the most important of the group. Typhoid fever is carried by water or by contaminated milk, and in various other ways, as well as by the house-fly. Kill all the house-flies and typhoid would still exist. On the other hand, malaria is carried only by the mosquito, because an essential part of the development of the malarial parasite is undergone in this insect. Exterminate all of the mosquitoes of certain species and the dissemination of human malaria is absolutely prevented.

Once an arthropod becomes an essential host for a given parasite it may disseminate infection in three different ways:

1. by infecting man or animals who ingest it. It is thus, for example, that man, dog, or cat, becomes infected with the double-pored dog tapeworm, ***Dipylidium caninum***. The cysticercoids stage occurs in the dog louse, or in the dog or cat fleas, and by accidentally ingesting the infested insect the vertebrate becomes infested. Similarly, ***Hymenolepis diminuta***, a common tapeworm of rats and mice, and occasional in man, undergoes part of its life, cycle in various meal-infesting insects, and is accidentally taken up by its definitive host. It is very probable that man becomes infested with ***Dracunculus medinensis*** *(Filaria)* through swallowing in drinking water, the crustacean, *Cyclops*, containing the larvae of this worm.

2. By infecting man or animals on whose skin or mucous membranes the insect host may be crushed or may deposit its excrement. The pathogenic organism may then actively penetrate, or may be inoculated by scratching. The causative organism of typhus fever is thus transmitted by the body louse.

3. By direct inoculation by its bite, the insect host may transfer the parasite which has undergone development within it. The malaria parasite is thus transferred by mosquitoes; the Texas fever parasite by cattle ticks.

Insects transmit pathogens in different main ways:

1-Mechanical transmission

This consists of a simple transfer of the organism on contaminated mouthparts or other body parts**,** no multiplication or developmental change of the pathogen on,

or in the arthropod takes place during this type of transmission, examples of pathogens that are transmitted in this way include various enteroviruses, bacteria, and

Protozoa that have a direct faecal-oral transmission cycle.

2-Biological transmission

The most important type of transmission by arthropods is biological transmission. As the name implies, the body of the arthropod vector in order to complete its life cycle. pathogen must undergo some type of biological development in the body of the arthropod vector in order to complete its life cycle.

There are four types of biological transmission.

A*Propagative transmission
Propagative transmission occurs when the organism ingested with the blood meal undergoes simple multiplication in the body of the arthropod. Arboviruses, for example, replicate extensively in various tissues of mosquitos, flies and ticks, and are transmitted to a new host in the salivary fluid of the arthropod when it takes a blood meal.

B*Cyclopropagative transmission
In this type of transmission, the pathogen undergoes a Developmental cycle (changes from one stage to another) as well as multiplication in the body of the arthropod. The best example of a disease transmitted in this way is Malaria, in which a single zygote may give rise to >200,000 sporozoites.

C*Cyclodevelopmental transmission
In cyclodevelopmental transmission the pathogen undergoes developmental changes from one stage to another, but does not multiply. With the filariae, for example, a single microfilaria ingested by a mosquito may result in only one third-stage infective larva. In most instances, however, the number of infective larvae is significantly lower than the number of microfilariae ingested with the blood meal.

D*Vertical and direct transmission

Some viruses and rickettsiae are transmitted from the female parent arthropod through the eggs to the offspring. If the pathogen actually infects the developing egg, this is termed ‘transovarial transmission’. With some arboviruses, however, only the ovarial sheath and oviduct are infected, and the egg becomes infected as it passes down the oviduct and is inseminated. This type is distinguished from transovarial transmission and is called ‘vertical Transmission’

. **Examples of diseases transmitted by Insects**

MOSQUITOES

Mosquitoes are found nearly everywhere in the world. They are equipped with a needle-like mouthpart, the proboscis, to suck up their food. Male mosquitoes only feed on plant juices but the females must suck blood. Several species feed exclusively on human blood and consequently become VECTORS of disease, transmitting disease organisms from one person to another in their quest for blood meals.

In the tropics, mosquitoes transmit malaria, certain types of filariasis, yellow fever, dengue fever and some strains of viral encephalitis. Many mosquito species bite at night, such as the *Anopheles* genus, which spreads malaria, but the day-biting *Aedes* is responsible for spreading the yellow fever virus. In Asia, the Far East and Africa, some Filarial worms are transmitted by mosquitoes. All along the East African coastal region, *Culex* and *Anopheles* mosquitoes carry the *Wucheraria bancrofti* worms from one infected person to another. The worms settle in the tissues of infected persons who may develop symptoms such as scrotal swelling in men and eventually, elephantiasis. Short-term travellers are not usually at risk though, because so many bites are needed to pass on the disease.

BLACKFLIES

These small biting flies breed in water, especially fast-flowing rivers and streams, and are the only vectors of river blindness (onchocerciasis) in sub-Saharan Africa. Their method of biting differs from mosquitoes because they tear and rasp the skin with their mouthparts, creating a pool of blood which they can then suck up. The microscopic larvae of the Onchocerca worms live in human skin and are picked up from an infected person by the biting flies. The tiny worms develop in the blackfly and migrate back to the mouthparts from where they can infect a new person. The infection is commonest in West and Central Africa, where the most serious symptom of the disease is blindness.

TSETSE AND TABANID FLIES

Tsetse flies only occur in sub-Saharan Africa where they are the vectors of human and animal trypanosomiasis. The human disease is known as sleeping sickness. The adult Tsetse fly is a bit larger than a housefly and is recognized by its scissor-like wings and its

long, forward-pointing proboscis. Typically the flies are attracted to dark, moving objects, making them quite a pest on safaris in some African parks. The chronic form of sleeping sickness occurs in West Africa and the patient can waste away over a period of many years before death occurs. The East African species of trypanosomiasis is very rare nowadays with limited distribution but is potentially much more virulent than the West African type. It maintains a reservoir of infection in wild animals, mainly antelope-type species.

The day-biting *Chrysops* is a Tabanid fly about the same size as a tsetse fly. In the forested regions of central Africa its bite can infect a person with a filarial worm called *Loa loa*, which migrates through the tissues under the skin, and may even cross the eye. An infected person experiences intense itching and swellings (Calabar swellings).

SANDFLIES AND MIDGES

Sandflies are tiny, hairy flies with tent-like wings, which prefer semi-arid regions, breeding in leaf litter, termite mounds and other moist microhabitats. They bite visitors to such areas, such as boys herding cattle, and transmit a disease called leishmaniasis. The visceral type, otherwise known as kala azar, invades the spleen and over a period of time leads to death if untreated. The cutaneous form develops as a defined and often disfiguring sore on the skin. Treatment of both types involves at least 20 days of daily injections. Leishmaniasis occurs in Africa and South America.

Midges constitute a biting nuisance in many parts of the world, usually in the warmer season. They can bite in swarms, especially targeting the face, thus ruining many a camping trip, tiny though they are. Some species of midge can also transmit some fairly harmless species of filarial worms in both Africa and South America.

FLEAS

Flea bites are some of the most irritating of all. Although there is a “human flea”, humans can also be bitten by cat, dog and rat fleas, among others. The rat flea carries the deadly plague bacteria, *Yersinia pestis*. Outbreaks of plague still occur today, mainly in crowded slum conditions where rats, fleas and man share the same habitat. Fleas can also transmit murine typhus, which usually leads to rashes and fever. Accidental swallowing of dog or cat fleas can result in certain tapeworm infections, including the dog tapeworm. This is especially so if young children fondle their pets too closely.

The jigger flea, Tunga, is famous for the localised itching it causes. The female burrows into the skin from where she lays her eggs. During this process she swells up and remains embedded in her host after death. “Jiggers” are still common in the rural tropics where people rarely wear shoes, exposing their toes to the fleas.

LICE

Of the three types of human lice only body lice can transmit disease, whereas head lice
and pubic lice cause misery from their itchy bites. Body lice proliferate in famine and
war situations, where people are unlikely to wash or change their clothes frequently.
Street children are often plagued by body lice, which live in the seams of clothing, only
leaving the cloth to have a blood meal on the host. Body lice act as vectors of epidemic
typhus and Trench fever, which are not transmitted to man by the bite of the louse but
through the louse faeces.

BEDBUGS AND OTHER BUGS

Bedbugs are familiar to schoolchildren and students who reside in dormitories where
furniture and mattresses have not been changed for a long time. These flat, secretive
insects live in cracks of furniture and seams of mattresses, crawling out at night to feed
on the blood of their sleeping victims.

Reduuvid bugs belong to the same order of insects as bedbugs and in South America,
transmit Chagas disease, another type of trypanosomiasis, through their infected faeces.

OTHER FLIES

Some flies belonging to the same class of insects as houseflies, are called myiasis flies.
The Tumbu or Mango fly likes to lay its eggs in clothing left out to dry on the grass and if
the clothes are not ironed, each egg hatches into a larva, which burrows into the skin and
forms a boil. The developing larva eventually emerges but not before causing pain and
irritation. More rarely, some fly larvae suck blood (the Congo floor maggot) while
others feed on deeper tissues, especially if they find a wound or soft skin through which
they can burrow.

Note that biting mites and ticks are also vectors of some viruses and bacteria, but they are
not insects, being related to spiders(Class Arachnida).