Insects and Micro-Organisms.

Long before mosquitoes were known to be the conveyers of malaria, in the very early days of bacteriology, Tizzoni and Cattani discovered that flies taken from cholera corpses carried cholera bacteria upon their bodies. A pretty experiment, showing with what complete justification these insects may be regarded as the express companies of a bacterial community, may be made by infecting the feet of flies with microbes which produce a pigment, and then allowing the insects to walk over the surface of some culture material. Their peregrinations are easily traced later when, on incubation, the coloured growths of bacteria appear wherever contact with the surface has taken place. If the *Bacillus prodigiosus* which, as is well known, produces a crimson growth, is allowed to infect the feet of a fly, and the fly is then compelled to walk over some slices of potato, it will be subsequently found that its feet have left the surface red. If, instead of infecting the fly with a harmless saphrophyte, typhoidal material be substituted, a vivid picture is at once presented of how surfaces with which the fly may subsequently come in contact, including foods, can become impregnated with typhoid bacteria. This evidence tends to show that water is not necessarily the most common conveyor of enteric fever, although it undoubtedly plays an important part.

The early researches of the investigators referred to awakened so much interest that numerous experiments followed with the object of estimating the responsibility of spreading disease in regard to other insects and by other means. Dewèvre succeeded in producing tuberculosis by means of an emulsion of bugs taken from a bed occupied by a consumptive patient, and methods were adopted by which the fate of various bacteria in the intestinal tract of different insects was ascertained—whether they were subsequently excreted from the body in a living and virulent condition, or whether their sojourn within the insect destroyed their pathogenic power.

The artificial feeding of flies with food infected with various disease bacteria, such as tubercle, cholera, typhoid and anthrax bacilli, enabled Celli to assert that these micro-organisms could pass unharmed through the digestive organs of flies, being recoverable in a living condition in their excrements. Later, similar experiments with plague bacilli led to the same conclusion. Careful research, however, has elicited the interesting fact that the fate of a particular micro-organism is not identical when consumed by all insects. For example, a residence in the bodies of flies and various beetles did not affect the anthrax bacillus, but it was rapidly destroyed in the digestive organs of fleas and bed-bugs. Similarly, Hankin has found, in regard to plague bacilli, that they were unharmed in the bodies of ants and flies, and were recoverable in a virulent condition from the excrements of these insects, while in the bodies of bed-bugs (*Cimex lectularius* is meant, of course), they were rendered harmless. Again, about two years ago, Küster made experiments in a similar direction with the common cockroach, an insect which, originally supposed to have been brought from Europe to the United States, having been conveyed to that continent from Asia, is now found in such numbers that it is a fairly common household pest. Although anthrax bacilli were recoverable from the excrements of these insects in a living and virulent condition, in no single instance were chicken cholera bacilli similarly found, although in the case of both micro-organisms exactly the same methods were adopted for their introduction into the body of the insect. Upon the other hand, tubercle bacilli, like the anthrax bacilli, passed through the body of the cockroach without suffering any important change, for animals succumbed to typical tuberculous infection after being inoculated with the excrement, in which they were present in very large numbers. As regards plague bacilli, Küster found that they were recoverable from freshly deposited excrements in a virulent state, but not from excrements which had been allowed to stand for twenty-four hours before being examined. In no case did the cockroach suffer any apparent inconvenience from the presence within its body of these varied and markedly pathogenic bacteria. But this indifference or immunity from infection in reference to disease-producing microbes is not universal among insects, for already, with the comparatively small number of investigations that have been made, it has been found that they possess different degrees of susceptibility in infection from pathogenic bacteria. According to Hankin, Nuttall, and others, fleas, mosquitoes, and ants are not affected in any way by the presence of plague bacilli, but flies die when infected by these micro-organisms.

The culpability of mosquitoes in the conveyance of yellow fever has now been firmly established, and the partial responsibility of flies for the spread of typhoid fever during the war with Spain, as well as during the South African conflict, is beyond reasonable doubt. Kaposi has given an instance in which leprosy was con-

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