Effect on some Blood-sucking Arthropods of 'Gammexane' when Fed to a Rabbit

THE physiology and nutrition of the bedbug (*Cimex lectularius*) has been the subject of investigation in this laboratory for a number of years. A preliminary report has been published[1], and a paper dealing with the matter more fully is in the press. One of the problems we have set ourselves is to make the blood of the host unsuitable for the bedbug by altering it in one way or another. The ultimate aim was to find some substance, non-toxic for the host, which when fed to animals would kill or control bedbugs and other blood-sucking arthropods. Numerous attempts in this direction, with a wide variety of materials, have been made, and some success has been obtained. Recently, through the kindness of Dr. W. C. Walmsley, of African Explosives and Chemical Industries, Ltd., Northrand, a few grams of the pure gamma isomer of hexachlorocyclohexane was obtained. Results with this substance have been so striking that it has been considered of interest to make them known immediately.

The 'Gammexane' was powdered and mixed with a solution of agar. The agar, when set, was cut into portions each of which contained approximately 50 mgm. One of these portions was fed to a rabbit weighing 1,730 gm. every morning. The arthropods, from known healthy stocks, were confined in glass tubes, covered with gauze, and placed on the rabbit's ear. In the case of the mosquitoes, a small gauze cage was applied to the shaved side of the animal.

Toxic effects on blood-sucking arthropods became evident on the second day, that is, after the rabbit had taken a total dose of 100 mgm. of 'Gammexane'. It will be convenient to give the results of experiments done after a total dose of 200–250 mgm. of 'Gammexane' had been given to the rabbit.

Cimex lectularius. Feed fully in all stages and show signs of paralysis immediately after feeding. First-stage nymphs were given their first meal on the 'Gammexane' rabbit, subsequent instars were reared to each particular stage on a normal animal and then fed on the 'Gammexane' rabbit. The mortalities, within 24 hours, for each instar were as follows: I, 50–90 per cent; II, 50 per cent; III, 50 per cent; IV, 33 per cent. Adults also show signs of paralysis immediately after feeding, but recover completely within 24 hours. Egg-laying is apparently not impaired, though no record was kept of the number of eggs laid per female. Nymphs which survive their first feed, moult, and are then again fed on the 'Gammexane' rabbit, show approximately the same death-rate as nymphs of the same stage feeding for the first time. Surviving nymphs are, therefore, not resistant to subsequent feeds, and a colony of bedbugs would have little chance of surviving many generations if they feed continuously on a 'Gammexane' animal.

Aedes ægypti. Feed fully and show signs of paralysis, for example, inability to rise from the bottom of the cage, within one hour. All fully fed females died within 24 hours. Females which did not feed and males confined in the same cage were unaffected.

Ornithodorus moubata. Attach immediately but do not feed fully (adults take only an average of 9 mgm. of blood), after which they immediately detach themselves and show obvious signs of distress. Incoordination of movement and inability to walk in a straight line away from light are the most obvious signs. These signs persist for days; some ticks appear to die, others linger on with progressing signs of toxæmia. To date, ten days later, no recoveries have been noted.

Kirkwood and Phillips, working with *Saccharomyces cerevisiæ*, have shown that *i*-inositol inhibits the effect of 'Gammexane'. It is of interest to note that an intravenous injection of 10 c.c. of a 5 per cent solution of *i*-inositol into a rabbit after it had had a total dose of 250 mgm. of 'Gammexane' did not reduce the toxicity of its blood for *O. moubata* fed a few minutes after the injection.

The toxicity of 'Gammexane', when fed to animals continuously, is, so far as I am aware, not known. This will have to be determined. The fact is established, however, that it is possible to interfere with the economy of blood-sucking arthropods by feeding insecticides to the host. The use of such a method in the veterinary sphere appears to have great possibilities.

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[1] De Meillon, B., and Goldberg, L., *Nature*, **158**, 269 (1946).
[2] Kirkwood, S., and Phillips, P. H., *J. Biol. Chem.*, **163**, 251 (1946).

Physiological Isolating Mechanisms and Selection within the Species *Gasterosteus aculeatus* L.

PREVIOUS work on the osmo-regulatory properties in relation to the migration of the stickleback[1] attracted our attention to physiological differences between 'forms' of this species, morphologically distinct, which Bertin[2] believed to represent modifications of a single genetic type.

Further investigations[3] provided physiological causes for the characteristic geographical distribution of these forms. The extension of the study of the osmo-regulatory properties of adult specimens, morphologically distinct as regards their number of lateral shields, at different temperatures proved the existence of physiological barriers between adult populations.

In order to investigate whether these physiological characters are in fact genetic, we undertook a breeding experiment which involved the rearing of approximately 30,000 eggs from ninety pairs of sticklebacks. The parents came from two populations, one of the form *gymnura* with a low mean plate-number, the other of *semiarmata* and *trachura* forms, with a high mean plate-number. The artificially fertilized eggs were allowed to develop at a constant temperature of 23° C. and at different salinities. The different salinities were produced from artificial sea water or ordinary fresh water, dilutions being made with glass-distilled water. The accompanying graph shows the differences in hatching percentages of the eggs.

At high and low salinities, the differences are especially sharp. Other experiments show that these differences are increased at lower temperatures. It seems probable, therefore, that under natural conditions of temperature the two populations differ sharply in their reproductive adjustment to the salinity of the habitat.

Death-rates at given salinities are not at random, but selective. This is shown by the correlations be-