REVIEWS AND ABSTRACTS

HELEN LOUISE DURKEE

INSECTICIDE RESISTANCE IN ARTHROPODS. By A. W. A. Brown. World Health Organization Monograph Series No. 38. pp. 240, Fig. 29. Geneva 1958. U. S. $5.00—£1/5s. The fantastically active chlorinated hydrocarbon insecticides present us with the serious "dilemma of insecticide-resistance": the more of these insecticides that are used, the greater the amount of insecticide-resistance that will be encountered.

The long-term solution of this dilemma can come only from research—greatly intensified research—that will provide means for overcoming the hard, cold facts of genetic physiological resistance of insects to insecticides. Meanwhile, let us be thankful that all insects are not like the house fly—completely resistant to all known chlorinated hydrocarbon insecticides.

The attention that is being given to resistance to insecticides, instead of to susceptibility to insecticides, is like looking at the hole instead of the doughnut. Susceptibility to insecticides is the phenomenon by which insects, and the diseases they transmit, are controlled or eradicated. Resistance and susceptibility need to be kept in proper perspective. An unfortunate tendency has grown up, under conditions that are readily understandable, of black-listing as resistant a whole species when only a part of the population of that species has been found to be resistant. In at least one insect, *Aëdes aegypti*, its degree of resistance in different populations ranges from complete susceptibility in a huge area, to marked resistance in a much smaller, but still large area.

Even in a review in *Mosquito News* it may not be amiss to mention the fact that physiological resistance to insecticides is a genetic phenomenon that is merely revealed by insecticides, never produced by it. In most cases the vector control operator must concentrate the resistant genes very greatly before they become detectible by one or another of the quantitative procedures that have been developed to measure the degree of insecticide resistance.

There is much talk about "establishing a base line of susceptibility" of mosquitoes, especially *Anopheles*, to the insecticide to be used in any given control operation or eradication campaign. In practice, however, this never gets done because the present test methods are much too cumbersome for really widespread use, and they are nowhere near sensitive enough to detect resistant genes when they are present in the proportion of only a few parts per million.

The monograph contains a list of 692 references, published during the decade ending in mid-1957, and has four chapters: 1. The nature and characterization of resistance; 2. Taxonomic groups characteristically vectors to man (total 37 of which 23 are *Anopheles*); 3. The housefly; and 4. Taxonomic groups characteristically not vectors to man (20 groups).

The chapters are conveniently arranged, and they contain an excellent discussion of resistance in all its facets, genetic, physiological, and biochemical. In sum, the book is an excellent comprehensive summary and review of the status of insecticide-resistance in early 1958.

Surprising are the difficulties that exist in defining insecticide-resistance. The dividing line between "vigor tolerance" and incipient resistance is still a matter of guesswork. Your reviewer is surprised to learn that there is no recommended procedure for estimating the standard error of an LC_{50} that a mere earth-bound entomologist or vector control operator might use in order to determine the limits of confidence of the test results that he obtained.

Regrettable are the errors in Fig. 7 (p. 64) regarding the progress of the *Aëdes aegypti* eradication campaign in the Americas. In the text three lines are used to mention the eradication of *aegypti* from 15 countries in South and Central American, while the succeeding three pages are devoted to the DDT-resistant populations of *aegypti* that are present in the Caribbean area. There is the implication that insecticide-resistance has been a factor in the continental United States of America, whereas the truth is that eradication operations have barely been started and the only data your reviewer knows of indicate that *aegypti* is normally susceptible there. On page 14 there is an obvious non sequitur: "The outbreak of yellow fever in Trinidad in 1954 was contemporaneous with a failure to *Aëdes aegypti* on the island due to its DDT-resistance." The yellow fever in Trinidad was primarily jungle yellow fever, with the virus repeatedly isolated from wild-caught *Haemagogus sp.* mosquitoes.

Insecticide-resistance can be a serious problem—it already is in many places—and the geneticists insist that it is certain to become more serious. Be that as it may, the better our knowledge of the facts of the matter the better will be our handling of the resistance problems that confront us, until such time as more research, and better research, may provide precisely the tools that are needed to solve the dilemma.—J. Austin Kerr, M.D., Chevy Chase, Maryland.

INVESTIGATION OF EASTERN EQUINE ENCEPHALOMYELITIS. I. GENERAL ASPECTS. By Jungherr, E. L. and Wallis, R. C. Amer. J. Hyg. 67(1):1–3. 1958. In general, these studies indicate that the pheasant is a most susceptible vertebrate host and serves as a sentinel of dangerous concentrations of EEE virus for man and horses; that owing to high susceptibility to and mortality from EEE, the pheasant is usually in the role of a terminal host with minor contribution to the contagious cycle of the disease; that the build-up of virus concentration resulting from pheasant outbreaks can be minimized by prompt anticannibalistic measures and good managerial factors to take care of their species-peculiar space and protein requirements, and that these factors should be taken into account in the elucidation of the ecology of EEE in nature.—Excerpt from text.

II. OUTBREAKS IN CONNECTICUT PHEASANTS. Amer. J. Hyg. 67(1):4–9. 1958.

III. PATHOLOGY IN PHEASANTS AND INCIDENTAL OBSERVATIONS IN FERAL BIRDS. Amer. J. Hyg. 67(1):10–20. 1958.

IV. SUSCEPTIBILITY AND TRANSMISSION STUDIES WITH VIRUS OF PHEASANT ORIGIN. Amer. J. Hyg. 67(1):21–34. 1958.

V. ENTOMOLOGIC AND ECOLOGIC FIELD STUDIES. By Wallis, R. C., Jungherr, E. L., Luginbuhl, R. E., Helmboldt, C. F., Satriano, S. F., Williamson, L. A., and Lamson, A. L. Amer. J. Hyg. 67(1):35–45. 1958. Results of a 3-year study of mosquito populations and ecology of eastern equine encephalomyelitis areas in Connecticut are summarized. Twenty farms where the disease occurred were investigated during the late summer season while virus activity was present. Year-round studies were conducted from 1953 to 1956 in representative fresh-water and salt-water swamp areas.

Each site where the disease has occurred in Connecticut has been in, or adjacent to, fresh-water swampy woodland or fresh-water swamp-forest border locations adequate for abundant mosquito breeding. The forest and woodland harbored a wide variety of migratory and resident wild bird life. The mosquito population was predominantly composed of woodland species among which *Culex restuans* and *Aedes triseriatus* were prominent. The distribution of *Aedes vexans* extended to all known infected areas, but salt-marsh species were restricted to 4 of 14 such areas investigated. The statewide distribution of *Culiseta melanura* was not established, but early summer population build-ups and feeding activity of *Culiseta* species centered around pheasant pens were observed.

Transmission in pheasant flocks during the cool fall weather beyond the peak of the mosquito season was by secondary contact transmission within the pens. However, study of mortality records of the outbreaks indicated that initial deaths occurred earlier while mosquito activity was high.

Mosquito pools totalling 5,864 specimens were prepared for virus study with negative results. It was suggested that Connecticut's forests and woodlands, which cover ⅔ of the state provide a "sylvan" ecology in which disseminating wild bird hosts and potential mosquito vectors are so widely dispersed that eastern equine encephalomyelitis remains essentially an agricultural and wildlife problem.—Authors' summary.

(A list of 62 references completes this symposium.)

NOTES ON THE BREEDING HABITS OF SOME CULICINE MOSQUITOES (DIPTERA: CULICIDAE) IN SOUTHERN GHANA. By Surtees, G. Proc. R. ent. Soc. Lond. (A) 33(4–6):88–92. 1958. 11 refs. It would seem from this survey that the mosquito species had well defined areas of breeding and within these areas preferences for particular breeding site types. For instance, *E. chrysogaster* bred most abundantly in the cocoa plantation and showed a preference for decaying cocoa husks, *E. oedipodius* also in the cocoa was almost entirely restricted to rolled leaves. *U. ornata* was to be found most abundantly alongside the reservoir, breeding in pineapple leaf axils, whilst *A. simpsoni* was largely restricted to the residential areas and bred most abundantly in banana leaf axils. *U. fusca* was only found in rock pools alongside the reservoir. Furthermore, each of the major areas seemed to have a dominant culicine species, *E. chrysogaster*, *U. ornata* and *A. simpsoni* playing these roles in the cocoa plantation, reservoir and residential areas respectively. It is interesting to note that within the cocoa plantation 14 culicine species were recorded, whilst only 8 different species were found in both the reservoir and residential areas.—Author's conclusions. (The 19 culicine species taken were: *Eretmapodites chrysogaster* Grah. *E. penicillatus* Edw., *E. grahami* Edw, *E. oedipodius* Grah., *E. sylvestris* Ing. and de Meil., *E. quinquevittatus* Theob., *Culex (Culiciomyia) nebulosus* Theob., *C. (Culex) ingrami* Edw., *C. (Culex) annulioris* Theob., *C. (Culex) perfidiosus* Theob., *C. (Neoculex) rima* Theob., *Aedes (Stegomyia) simpsoni* Theob., *A. (Stegomyia) apicoargenteus* Theob., *A. (Stegomyia) aegypti* Linn., *Harpagomyia taeniarostris* Theob., *Uranotaenia ornata* Theob., *U. fusca* Theob., *U. anpulata* Theob., and *U. candidipes* Edw.)

NOTES ON THE BIOLOGY OF A NEW SUBSPECIES OF *Anopheles wellcomei* (DIPTERA: CULICIDAE) FROM EAST AFRICA, AND ON THE DISTRIBUTION OF RELATED FORMS. By Gillies, M. T. Proc. R. ent. Soc. London (A) 33(1–3):9–14. 1958. 11 refs. 9 figs. A new subspecies of *Anopheles wellcomei*, geographically isolated from other forms of the species, is described from Tanganyika and Kenya. The distribution of this and of other forms is discussed, and notes are given on its behavior.

A. wellcomei erepens (subsp. n.) is most abundant during the months of May to August, following the main rainy season. The larvae have been found in permanent and semi-permanent swamps and streams in the South Pare District of Tanganyika. They show the group habit of climbing up the stems of emergent plants or stakes, thus maintaining themselves a little above the main water surface. They presumably achieve this position by means of the belts of thoracic and abdominal spicules, characteristic of members of the *distinctus-wellcomei* group. It seems that they can maintain themselves in position despite some degree of disturbance of the water surface.

The adult mosquitoes have been caught biting man at night on numerous occasions. Biting has been observed more frequently outside than inside houses, although it cannot be claimed that a critical comparison has been made of the two activities. They can, however, be caught most abundantly either biting cattle in the open or resting round thorn animal enclosures at night, and it seems that they are primarily zoophilic. No glands infected with sporozoites were found amongst 127 mosquitoes dissected in South Pare District. It is not impossible, however, that an occasional specimen may live to transmit malaria, as has been shown for *A. wellcomei wellcomei* in the northern Cameroons (Hamon *et al.* 1956). Moreover, Dr. A. Smith has observed *erepens* biting man in large numbers near the Ruvu River in Northern Tanganyika, even after the houses had been sprayed with residual insecticides. In the presence of other more potent vectors it could obviously be of no importance as a malaria carrier, but in localities where it is abundant it should be regarded with suspicion as potentially capable of maintaining lowgrade transmission out-of-doors, especially if it should be found that house spraying has failed to eliminate malaria completely.—Author's summary and excerpts from text.