REVIEWS AND ABSTRACTS

YELLOW FEVER. George K. Strode, Editor, and John C. Bugher, J. Austin Kerr, Hugh H. Smith, Kenneth C. Smithburn, Richard M. Taylor, Max Theiler, Andrew J. Warren, and Loring Whitman. Published by McGraw-Hill 1951, 710 pages, over 600 ref. This book has presented a fascinating story of one of the undertakings of The Rockefeller Foundation in the world-wide campaign aganst yellow fever from 1916 through 1949. During this period the Foundation contributed over 13 million dollars, and 76 scientists served a total of 465 man-years. The largest expenditure, over 5 million dollars, was made in Brazil.

There are 10 chapters, each prepared by one of the authors (Bugher 2), and editor; 1, Landmarks in the Conquest of Yellow Fever; 2, The Virus; 3, The Pathology of Yellow Fever; 4, Immunology; 5, The Arthropod Vectors of Yellow Fever; 6, The Mammalian Host in Yellow Fever; 7, The Clinical Aspects and Diagnosis of Yellow Fever; 8, Epidemiology; 9, Controlling Yellow Fever; 10, Costs and Man Power. Chapter 5 is one of the most interesting to the majority of *Mosquito News* readers for here is discussed the role of mosquitoes in the transmission of the disease; relationship between mosquitoes and the virus; relation of mosquito ecology to transmission of the fever; species of mosquitoes of interest in relation to the disease; 31 in South America, 20 in Africa, although fortunately not every one is susceptible to the disease; and arthropods other than mosquitoes with which sporadic studies were made. As Dr. Strode points out, "The comparatively vast scientific effort expended in laboratory and field work had its moments of sadness and drama. During the campaign 6 scientists on active duty succumbed to the disease." One of these, Theodore B. Hayne, and the writer spent many intriguing hours collecting and studying anophelines in the rice fields of Arkansas in 1921 under the supervision of Dr. M. A. Barber. Everyone interested in the biological sciences will find this book of great interest and value.—H. H. Stage.

THE DISTRIBUTION OF CERTAIN LIQUIDS IN THE ESOPHAGEAL DIVERTICULA AND STOMACH OF MOSQUITOES. By Helen Louise Trembley. Amer. Journ. Trop. Med. and Hyg. 1(4):693–710. 1952. This is a carefully planned, unusually detailed, comparative study of the distribution of blood, 5% glucose or honey containing neutral red, and blood-glucose or blood-honey mixtures (9:1 in 0.85% saline) in the midgut and esophageal diverticula (dorsal sacs and crop) of more than 4,500 adult mosquitoes (4 species of *Anopheles*, 4 species of *Aedes*, and *Culex pipiens*), with special reference to mode of feeding.

Mosquitoes that obtained blood by biting man were allowed to feed continuously until satiated, were interrupted twice until satiated, or were allowed to feed until only partially full (removed while biting). Heparinized chick blood, glucose and honey, and mixtures of these were fed through *Baudruche* and chick skin membranes and from moistened cellucotton.

Blood taken by bite or by imbibing from cellucotton was generally found in the midgut and in one or more diverticula of all *Anopheles* tested (*An. quadrimaculatus, An. freeborni, An. albimanus, An. aztecus*), in only one of the four species of *Aedes, atropalpus*, and in *Culex pipiens*. In three out of four species of *Aedes* blood taken under similar conditions was distributed *only* to the midgut, confirming the work of Bishop and Gilchrist and of Lumsden who worked with *Ae. aegypti*.

When allowed to feed without interruption, distribution of blood in diverticula was found to vary according to species and was not a generic phenomenon: Trembley writes "Each of the eight species . . . would perhaps fall into its own niche, and with one exception . . . would differ significantly from all others. . . ." This species difference in blood distribution was not so pronounced when mosquitoes fed from cellucotton. Significantly fewer *Culex pipiens* had blood in diverticula after partial blood meals. In all other species, however, there was no significant difference in distribution.

Sugary solutions either through membranes or from cellucotton were primarily but not exclusively found in the diverticula of all species. Forty-four per cent of mosquitoes with sugar solution in diverticula also had some in midgut. However, the midgut was generally not so fully distended as the diverticula.

Interruption in biting did not produce statistically significant increases in numbers of mosquitoes with blood in diverticula. Interrupted feeding to satiation whether from arm or from cellucotton did *not* cause blood to be shunted to diverticula in *Ae. aegypti*. However, it is of great interest that when mosquitoes took only a *partial* blood meal by *continuous bite*, blood was found in the diverticula of all six species used (including *Ae. aegypti*) and this observation may partially explain the findings of Pawan and Fisk who found blood in the diverticula of *aegypti*. This observation also indicates that presence of blood in diverticula cannot be due to overdistention of the midgut.

Blood-glucose or blood-honey taken though membranes by *Ae. aegypti* passed primarily to the midgut. Trembley writes "There was a slight increase in the number of mosquitoes with blood in the diverticula when sugary solutions were added [to blood] . . .".

With the exception of *Culex pipiens*, there was

no regular sequence in filling of diverticula. In *C. pipiens* there was a tendency for blood to appear in the crop ahead of the dorsal diverticula.

Under the conditions used in this study (76° to 80° F.; R.H. 25 to 50%) 24 hours were required for emptying diverticula in *An. quadrimaculatus* and in *An. freeborni. C. pipiens* showed less tendency to empty diverticula in 24 hours. Trembley points out that peristalses are almost absent in dissected midguts of this species and hence might be responsible for such slow emptying.

Absence of mature ova did not ensure that blood would be dispatched entirely to the stomach.

The paper concludes with the pertinent warning that ". . . it is obvious that one cannot arbitrarily group these insects and refer to reactions or responses of 'mosquitoes'. This grouping, as well as insufficient numbers of mosquitoes observed, has been the outstanding weakness . . ." of much research on the complex study of the function of the diverticula in these insects.—Jack Colvard Jones.

STUDIES OF THE RESPONSES OF THE FEMALE *Aedes* MOSQUITO. PART IV. FIELD EXPERIMENTS ON CANADIAN SPECIES. Brown, A. W. A. Bull. Ent. Res. 42(2):575–582. 1951.

1. The responses of adult mosquitoes, consisting of several Canadian species of *Aedes,* were investigated under field conditions by employing heated and clothed robots.

2. Moisture increased the attractiveness of a warm body two to four times when the air temperature exceeded 60° F.; at cooler temperatures, surface moisture decreased the attractiveness.

3. Warmth increased the attractiveness of a body, so that a robot at 98° F. attracted three times as many mosquitoes as one at 50–65° F.

4. It may therefore be concluded that moisture is the major attractant factor when the air temperature exceeds 60° F., and warmth when the temperature is less than 60° F.

5. Carbon dioxide vapour emitted from an artificial head almost doubles the attractiveness of a warm body.

6. The vapours of ether and gasoline were significantly attractive. A sweat-soaked jerkin was more attractive than a water-soaked one.

7. Light colors were less attractive than dark ones, and luminescent dyes decreased the attractiveness of cloths. Green is less attractive than red or blue.

8. Glossy satins were less attractive than matt broadcloths. Greenish-khaki nylon cloth was much less attractive than khaki drill or cotton.

9. There was no evidence of interspecific differences in the responses of the mosquitoes investigated.—Author's summary.

ON THE DISTRIBUTION OF THE ANOPHELINE MOSQUITOES. (In Japanese.) Omori, Nanzaburo. Japanese J. Sanitary Zoology (Eisei Dobutsu). 1(1):1. 1950. (Pub. by the Japan Society of Sanitary Entomology, c/o Research Institute for Natural Resources, 4-chome, Hyakunin-cho, Shinjuku-ku, Tokyo, Japan. $2.00.)

Several kinds of anopheline larvae were found breeding in the forests of Thailand, scattered in numerous ponds and river pools, far distant from human dwellings. It was supposed by the author that the blood meal of the adult mosquitoes in that area came from wild animals, wandering in the forest. Breeding places of the following anophelines were mentioned: *A. minimus, A. maculatus, A. barbirostris, A. hyrcanus, A. annularis, A. aitkeni, A. insulaeflorum,* and *A. barbumbrosus.*—Toyohi Okada, Japan, and Don Pletsch. WHO, Taiwan.

ON MOSQUITOES OF HOKKAIDO. By Shogaki, Yukio. Jap. J. San. Zoology (Eisei Dobutsu). 1(1):2–3. 1950. (For Publisher and price see preceding abstract.) (In Japanese.) 14 species of mosquitoes were collected from various parts of Hokkaido, including a *Theobaldia* form which may be a new species, and forms of *Aedes excrucians* and *Aedes cinereus* which may be new subspecies. *Aedes albopictus* and *Culex tritaeniorhynchus* were not found.—Okada and Pletsch.

THE EGGS OF JAPANESE *Anopheles* (REPORT I). (In Japanese.) By Otsuru, Masamitsu and Miyagawa, Mitsuo. Jap. J. San. Zoology (Eisei Dobutsu). 1(1):3–4. 1950. (For publisher and price, see first abstract of this series.) Obvious seasonal variations were observed in the eggs of *Anopheles hyrcanus* variety *sinensis.* From autumn to winter the eggs showed a progressive decrease in the breadth of the dorsal surface owing to the approach of the dorsal fringes toward one another, finally dividing the dorsal surface into two parts. Another type of seasonal variation was recognized in a series which seemed to be *Anopheles hyrcanus* var. *sinensis.* No distinct differences in egg characteristics were recognized between *A. koreicus* and *A. edwardsi.* Characteristics of the egg of *A. lindesaii* var. *japonicus* were also observed.—Okada and Pletsch.

A CONTRIBUTION TO THE KNOWLEDGE OF *Anopheles sintonioides* IN HAINAN ISLAND. (In Japanese.) By Niimura, Taro. Jap. J. San. Zoology (Eisei Dobutsu). 1(1):6–7. 1950. (For publisher and price, see first abstract of this series.) The larvae of *Anopheles sintonioides* together with *Megarhinus sp.* were found in small water reservoirs, usually under trees in graveyards on Hainan Island. *A. sintonioides* could be induced to bite man. Fourteen attempts were made to transmit malaria by the bites of this species, but results were negative. Adults were not found in light trap collections.—Okada and Pletsch.

ON THE SEASONAL DSTRIBUTION OF ANOPHELINE MOSQUITOES IN CENTRAL CHINA. (In Japanese).

By Mashiko, Kikuya. Jap. J. San. Zoology (Eisei Dobutsu). 1(1):10–12. 1950. (For publisher and price, see first abstract of this series.) The author found 4 types of seasonal variation of anopheline larvae in Central China: the *sinensis* type, *maculatus* type, *minimus* type, and *lindesayi* type. The *sinensis* type (e.g. *A. hyrcanus sinensis*) had 3 peaks in June, August and October, respectively, the August peak being the lowest. The *maculatus* type (e.g. *A. maculatus, A. pattoni*) showed a peak in midsummer and almost no appearance from October to June of the succeeding year. The *minimus* type (e.g. *A. minimus* and probably *A. jeyporiensis*) showed peaks in October and a minimum population in April-May; the larvae were seen all through the year. The *lindesayi* type (e.g. *A. lindesayi* and *A. aitkeni*) showed a minimum in August and also in April, the larvae being found throughout the year.—Okada and Pletsch.

ON THE SEASONAL PREVALENCE OF A MALARIA MOSQUITO, *Anopheles hyrcanus sinensis* WIEDEMANN IN JAPAN. (In Japanese). By Nomura, Kenichi. Jap. J. San Zoology (Eisei Dobutsu). 1(1):18–19. 1950. (For publisher and price, see first abstract of this series.) The total numbers of anopheline larvae inhabiting a rice field are considered proportional to the order of appearance of larvae, population, population density of larvae, and the area of the rice field. The first two factors were thought to be influenced by air temperature, water temperature and density of the rice plants.—Okada and Pletsch.

A LARGE SCALE EXPERIMENT IN RICE FIELD MOSQUITO CONTROL. A. E. Whitehead. Ark. Agr. Expt. Sta. Rpt. Series 32, 15 pp. The test, conducted in Arkansas in 1951, included larval control on all rice grown on 22 sections of land, involving a total of almost 4,500 acres of rice. Two pounds of bentonite pellets containing 5 per cent of dieldrin to each acre of rice, were dispensed by an airplane. The material used and method of timing were based on three years of experiments by Prof. Whitehead and were reported in part at the March 1951 meeting of the American Mosquito Control Association in Chicago. Larval kills were 97% but only 77% of adult mosquitoes were killed.

A high proportion of the mosquitoes were *Psorophora confinnis* and *P. discolor*. Evidence from the experiment indicated an expenditure not exceeding $1 per acre. It was especially interesting to note that an experiment on such a large scale was made possible through contributions of materials by the American Colloid Company, Julius Hyman Co. and cash contributions by Monsanto Chemical Co., Arkansas Rice Growers Cooperative Association, Southern Rice Farms, Inc., Hartz Seed Co., Producers Rice Mill. First National Bank of Carlisle, Farm Bureau of De Witt, and Mr. M. H. Hopson, rice grower.—H. H. Stage.

Anopheles aztecus, MALARIA, AND MALARIA CONTROL IN THE VALLEY OF MEXICO. Downs, W. G. and Bordas, E. Journ. Nat. Malaria Soc. 10(4):350–358. 1951.

1. Malaria is endemic in the Xochimilco-Mixquic region of the Valley of Mexico at an altitude of 7,426 feet above sea level. *P. vivax* is the only species of endemic malaria. *A. aztecus* Hoffmann, 1935 has been found naturally infected in the region, can be readily infected in the laboratory, and has been shown to be able to transmit *P. vivax*. The species is commonly found in houses in the region and bites man freely. Basing judgment upon accumulated field and laboratory experience, it is considered as the sole malaria vector of importance in the region.

2. A malaria control program consisting of spraying of all houses and other buildings in the zones of the towns near the breeding areas, with DDT suspension made up from 50 per cent water-wettable powder, applied at the rate of 200 mgm. per square foot, has given, up to the present, excellent control of malaria. Parasite rates have dropped to zero and spleen rates have fallen markedly.

3. Control recommendations for the future are to re-spray after a two-year interval, and after that, to re-spray only when indicated by appearance of autochthonous cases of malaria.—Authors' summary.

FACTORS INFLUENCING THE SEARCH FOR ANOPHELINE LARVAE IN SARDINIA. Trapido, H. Journ. Nat. Malaria Soc. 10(4):318–326. 1951. Field experience in Sardinia illustrates how uncertain the method of dipping for anopheline larvae is in establishing their presence or absence, when populations are very low. The premise that anopheline larvae are at or near the water surface is not always valid. Experiments are reported demonstrating the extent of surface avoidance following mechanical disturbance for the species *Anopheles claviger, A. hispaniola, A. algeriensis* and *A. l.labranchiae*. *Anopheles l.labranchiae* is shown to return to the surface more rapidly than the other three species. One minute after being disturbed, two per cent of the *labranchiae*, 39 per cent of the *claviger*, 36 per cent of the *hispaniola*, and 45 per cent of the *algeriensis* were still submerged. In 328 trials with *labranchiae* larvae the maximum submergence time was three minutes. The comparable figures for the other species were: *claviger*, 14 minutes in 300 trials; *hispaniola*, 35 minutes in 258 trials; *algeriensis*, 4 minutes in 31 trials.—Author's summary.

THE ROLE OF *Aedes leucocelaenus* IN THE EPIDEMIOLOGY OF JUNGLE YELLOW FEVER IN BRAZIL. Kumm, H. W. and Cerqueira, N. L. Bull. Ent. Res. 42(1):195–199. 1951. *Aedes leucocelaenus* transmits yellow fever virus readily in the laboratory and has twice been found infected in nature. Except in south Brazil this

species is much less common than *Haemagogus spegazzinii* among day-biting sylvan mosquitoes captured with human bait. *A. leucocelaenus* has a wide distribution throughout the forested area of this country. As a natural vector of jungle yellow fever in the northern part of Brazil it is of secondary importance when compared to *H. spegazzinii*.—Authors' summary.

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