1940 Fukushi has brought evidence for multiplication in the vector which the reviewer considers overwhelming. The 1939 paper at least must have reached England, for it is abstracted in the *Review of Applied Mycology*. In any case, the discussion relating to multiplication of viruses in insects is unsatisfactory. Carelessness in citing literature is not confined to references regarding the researches of others but extends to some references made to Bawden's own papers. On page 162, for example, he quotes two papers by Bawden and Pirie, published in 1936 and 1937. The 1936 paper cited is not pertinent to the subject under discussion. Another paper by Bawden and Pirie published in 1936, which should have been cited, is not mentioned. The 1937 paper is incorrectly cited.

Chapter 1 gives a brief account of the history of plant virus research. Chapters 2 and 3 describe symptoms associated with representative virus diseases on different hosts and under different conditions. Chapter 4 discusses transmission by various methods. A rather complete list of the viruses known to be spread by insects is given. A statement on page 60 that sugar-cane mosaic is transmitted by aphids and by a leafhopper is in error. Sugar-cane mosaic is not known to be transmitted by any leafhopper.

Chapter 6 on virus strains, mutations and acquired immunity is one of the best. The new conception that most viruses exist in a number of strains has done much to clarify virus disease problems; this the author brings out forcibly. He discusses two types of behavior in virus-infected plants that have been described under the term "acquired immunity." The first type covers cases in which a disease is severe in the acute stage but mild in the chronic stage. The second covers cases in which plants affected by one strain of a virus become immune from infection by other strains of the same virus.

Serological reactions of the plant viruses are dealt with in Chapter 7, where the author shows how precipitin reactions, complement fixation, neutralization of infectivity and anaphylaxis reactions may be used in identifying viruses and in showing relationships between them as well as in quantitative measurements.

Chapters 8, 9, 10, 11 and 12 cover methods of purifying viruses, properties of purified virus preparations, optical properties of purified virus preparations, inactivation of viruses and sizes of virus particles. Chapter 13, on the physiology of virus-diseased plants, enumerates most of the chemical changes known to take place in affected plants. It is the reviewer's opinion that the book would have been improved if in these chapters more emphasis had been placed on the numerous experiments performed by Stanley and his associates in proving that the so-called virus protein isolated from plants affected by tobacco mosaic had the properties of tobacco mosaic virus, since it was this work that initiated a new era in virus research. In chapter 13, also, the movement and multiplication of viruses in different tissues are discussed.

Chapter 14 is on the naming and classification of viruses, and chapter 15 on control of virus diseases. In the last chapter, chapter 16, various views as to whether or not viruses are living and theories of their origin and mode of increase are presented.

The author has undoubtedly succeeded in describing and correlating recent advances in the study of plant viruses in the second edition in a more thoroughgoing way than in the first. It seems safe to predict that this edition will be received with the same enthusiasm that was accorded the first.

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ANOPHELES GAMBIAE

Anopheles gambiae in Brazil, 1930 to 1940. By FRED L. SOPER and D. BRUCE WILSON, 262 pp., 75 figs. New York: The Rockefeller Foundation.

WHEN we fight a common enemy we expect to share with our allies the burden of the cost of the war. If the fighting takes place in foreign lands, it is to our advantage, but by no means does that lessen our obligations. Brazil, with the aid of the Rockefeller Foundation, recently fought, and won, a war for most of the countries in the New World. The enemy was not a political one, but nevertheless is capable of great destruction of life and property, for it is one of the deadliest disease carriers known—*Anopheles gambiae.*

Anopheles gambiae is native to tropical Africa. Late in 1929 or early in 1930 it was carried across the South Atlantic to Natal, Brazil, probably by one of the fast mail-carrying French destroyers which were capable of traveling between Dakar and Natal in only four days. In the following years it spread along the coast northward from Natal to Caponga, a fishing village only forty-five kilometers from Fortaleza, and from the coast it advanced inland along the river valleys until, by 1940, it had invaded the upper reaches of the Jaguaribe and its tributaries as far as Madelena, Barra de Conceição and Quixará. Its range also included the valley of the Assú River as far as São Rafael, and the Apodí valley as far as São Sebastião and Augusto Severo. The migration was accomplished by infiltration, that is, by short flights from one breeding place to another and by transportation of the adult in various kinds of vehicles.

Almost everywhere the *gambiae* invasion was followed by severe malaria epidemics. The first outbreak occurred at Natal in 1930 and subsided when control measures eradicated the mosquito from that city. In

1931 it raged in river valleys northwest of Natal, but the period between 1932 and 1937 is referred to as the "silent era" because, although it was extending its range, the mosquito caused no noticeable increase in malaria. The epidemic of 1938 in the Jaguaribe valley, in the state of Ceará and along the coast and rivers of the state of Rio Grande do Norte was catastrophic. It was estimated that in June and July there were 100,000 cases of malaria with over 14,000 deaths. In 1939 more than 185,000 people in the two states were given treatment for the disease.

The Brazilian Ministry of Education and Health and the Rockefeller Foundation collaborated in organizing the Malaria Service of the Northeast, with headquarters at Fortaleza. The basic unit of the control organization was the zone—an area in which one man could apply larvicides to all breeding places in one week; or an area in which all houses could be sprayed by a disinsectization squad in one week. The zone inspector was responsible to the chief inspector, whose district generally included five zones. Several districts were combined into a post, which was in charge of a doctor, and the posts were grouped into a total of seven divisions, each of which was in charge of a more experienced doctor.

The severity of the epidemic necessitated the distribution of quinine and atebrine, but the real offensive against the insect involved the painstaking search for larvae in all possible breeding places and the application of larvicides, especially Paris green, by the zone inspectors. The attack on the larva was supplemented by systematic spraying of adult mosquitoes resting in houses; although this measure can not be relied upon for eradication of the mosquito, it did increase the effectiveness of the larvicidal program and prevented many cases of malaria by killing infected adults. But the objective of the counter-attack against *A. gambiae* was not merely to control malaria; it was the complete extermination of the species in Brazil. After surveys had established the distribution of the mosquito, a cordon was thrown about the periphery of its range, and further infiltration into uninfested areas was prevented by the use of larvicides and pyrethrum spray in a belt eight to twenty-five miles beyond the known limits of the infested area, while transportation of the adult through the barrier was prevented by disinsectization of all planes, boats, trains and other vehicles. Control measures were intensified at the border, and, working from this frontier zone inward, one area after another was cleared of the invader, until in November, 1940, the last individuals of *A. gambiae* were destroyed.

This, in brief, is the account of the *gambiae* invasion of Brazil. But the authors do more than simply repeat this story. In addition to emphasizing the need for constant vigilance against such insect invaders, they challenge the old concept of malaria control that aims only at reducing the vector population below a certain level by drainage and other methods that require many years for their success, and which never completely eradicate the disease. Can *A. gambiae* be exterminated from regions within its natural home in Africa? Can *A. pseudopunctipennis* be eradicated from river valleys in Peru? It is true that *gambiae's* habit of breeding in small water collections free of vegetation, and its attraction to human habitations, not only cause it to be a more dangerous malaria carrier but also make it more susceptible to control by larvicides and spraying. Other anophelines which have a wider selection of breeding places and which rest in the jungle may be much more difficult to attack, but would it be feasible to attempt an all-out "blitzkrieg" instead of simply keeping down their numbers by control measures which must be continued forever? Extermination of such mosquitoes may not be possible, but no one thought that *A. gambiae* could be eradicated from Brazil in less than two years.

The book is well worth thoughtful perusal by all those interested in control of insects of economic and medical importance, whether they be doctors, scientists or legislators.

L. E. ROZEBOOM

SPECIAL ARTICLES

EXTRACTION OF A HIGHLY POTENT PENICILLIN INACTIVATOR FROM PENICILLIN RESISTANT STAPHYLOCOCCI[1]

BY grinding a suspension of *E. coli* in a crushing mill, Abraham and Chain[2] in 1940 produced an enzyme-like substance capable of completely inhibiting penicillin. This substance, called penicillinase, was presumably intracellular, for penicillin was not destroyed by the actively growing organisms, and no penicillin inactivator was present in culture filtrates. No penicillinase could be extracted from penicillin sensitive staphylococci, or, in later experiments,[3] from a strain of *Staph. aureus* made insensitive by repeated

[1] The penicillin was provided by the Office of Scientific Research and Development from supplies assigned by the Committee on Medical Research for experimental investigators recommended by the Committee on Chemotherapeutics and Other Agents of the National Research Council.

[2] E. P. Abraham and E. Chain, *Nature*, 146: 837, 1940.

[3] E. P. Abraham, E. Chain, C. M. Fletcher, A. D. Gardner, N. G. Heatley and M. A. Jennings, *Lancet*, 2: 177, 1941.