about 19 minutes at a growth rate of 5.9 $cm^3$ per minute.

It would, doubtless, be quite interesting to develop a technique and grow a large bead to find just how large and how stable it could be. Several attempts to do this have failed, and the phenomenon must be viewed as a combination of happy probabilities.

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# SCIENTIFIC BOOKS

## RECENT PUBLICATIONS OF THE BRITISH MUSEUM (NATURAL HISTORY)

THE war of 1914–18 reduced the publication of zoological research to about half its normal amount, but in the last few years there has been a complete recovery, so far as the total output is concerned. Had it been possible to maintain peace and provide opportunities for scientific cooperation all over the world, it was to be expected that the biological sciences would continue to develop at a constantly accelerating rate, to a future which we can hardly imagine. Knowledge would not only increase rapidly, but would be so organized in catalogues, monographs and the like that in spite of its bulk and variety, it would be increasingly usable. Mankind would come to an understanding of living nature far beyond that which was possible even a few decades ago.

In this great work the British Museum (Natural History) has long been a leader. Its catalogues, at first designed to enumerate the specimens in the Museum, soon developed into monographs of the various groups of animals—the birds, reptiles, fishes of the world; or detailed and beautifully illustrated revisions of particular groups, such as Boulenger's four-volume work on the "Fresh Water Fishes of Africa." Few people have any idea of the magnitude and importance of the British Museum publications, because they are rarely seen assembled together, and no one has occasion to consult all the different works dealing with so many different topics. It must be said, however, that these revisions and monographs not only serve the needs of specialists, but also contain much of general interest for the biologist, if he has patience to dig it out. The present review deals with some of the most recent publications, quite inadequately, yet perhaps with sufficient detail to arouse interest.

(1) *The British Mosquitoes.* By J. F. MARSHALL. Pp. 341. 1938. The author of this work, finding mosquitoes exceedingly abundant about his home on Hayling Island, became interested in their study and organized a control scheme in 1921. This led to the establishment of the "now well-known British Mosquito Control Institute, which has been ever since a centre for both pure and applied research upon mosquitoes, and is in addition an admirable educational museum." The British mosquitoes had been so extensively and intensively studied that one might have supposed there was nothing more to be done, but Marshall's book, dealing with every phase of the subject and beautifully illustrated, is outstanding for its originality and marks a great advance in our knowledge, as may be seen by comparison with the "Handbook of British Mosquitoes" published by the British Museum in 1920. I can strongly recommend this new mosquito book for consultation in all entomological laboratories, especially as a model for those doing graduate work.

(2) *Mosquitoes of the Ethiopian Region.* Part 1: *Larval Bionomics of Mosquitoes and Taxonomy of Culicine Larvae.* By G. H. E. HOPKINS, of the Department of Agriculture, Uganda. Part 2: *Anophelini, Adults and Early Stages.* By the late Dr. ALWEN M. EVANS, of the Liverpool School of Tropical Medicine. The first of these works (250 pp.) catalogues the species and records what is known of the larvae and their habits. The second book (404 pp.), by Miss Evans, has to do with the group which is concerned with the transmission of malaria and is therefore of prime importance in connection with public health. Miss Evans, long known as a keen student of mosquitoes, was fortunately able to visit Africa a few years ago, and after her return practically completed her monograph, and took it to the Museum. She was evidently ill at the time, and in August, 1937, she died, to the great regret of those who knew her or knew of her work. Dr. F. W. Edwards, of the Museum, saw the book through the press, adding some items to bring it quite up to date, and it was published in May, 1938.

(3) *Bombyliidae of Palestine.* By E. E. AUSTEN. Pp. 188. 1937. Major Austen, who was keeper of the Department of Entomology in the Museum, took part in the Palestine campaigns of 1917–1918, and while engaged in military service was struck by the number and variety and also the beauty of the Bombyliidae or bee-flies of that country. He accordingly collected all he could and brought together those which had been collected by others, and when on his retirement he found sufficient leisure for the work prepared the detailed and beautifully illustrated volume published in 1937. The results were astonishing: out of 128 species or varieties, 46 proved to be new. These flies are of economic importance, being parasitic in the larval state on other insects, some of them on injurious locusts.

(4) *Monograph of the Genus Erebia.* By B. C. S. WARREN. Pp. 407 and 104 plates. 1936. This is a model treatment of an important genus of butterflies found in the Northern Hemisphere. The adult insects only are dealt with, as so little is known of the larvae, which are grass-feeders. The interest of the book for biologists in general centers in the detailed discussions of geographical distribution and the differentiation of species, subspecies and mutations. The author's views and results are provocative of lengthy discussion, which can not be attempted here.

(5) *A Monograph of the Pierine Genus Delias.* By G. TALBOT. In six parts, concluding part VI published in 1937, bringing the pages to 656 and the plates (several colored) to 71. These butterflies, abundant and varied in the Oriental Tropics, but absent from Africa, have been studied in great detail by the author who has examined the structural characters and so put the species on a firm foundation. Mr. Talbot was curator of the private museum of Mr. Joicey at Witley, Surrey. In 1932 Mr. Joicey died, and later his entire collection of Delias, numbering 6,800 specimens, was presented to the British Museum. The monograph is thus based on abundant material and constitutes a revision in the best sense of the word; a new vision would more literally describe it.

(6) *A Catalogue of the Ammonites of the Liassic Family Liparoceratidae.* By L. F. SPATH. Pp. 191 and 26 photographic plates. 1938. In Bristol, many years ago, when the fossil-collectors were seen going out with their hammers, it used to be a current joke to say: "Those are the Hittites, going after the Ammonites." The Ammonite fauna preserved in the rocks of Southern England is extraordinarily rich, and the said Hittites, over a period of many years, have accumulated very large collections, which show the evolution of types from one age to another. Dr. Spath's study of one group of these molluscs, published in the most sumptuous form, enables the reader to examine the evidence in detail and form his own opinions. After reading the work I felt that in some cases the interpretations given might be criticized, but could only admire the elegant presentation of the facts.

(7) *The British Rhaetic Flora.* By T. M. HARRIS. Pp. 84, 5 plates. 1938. A critical study of a small but important flora by the professor of botany in the University of Reading, who is especially known for his excellent work on fossil plants from Greenland. Botanists will be interested to find that one of the plants, an alga, is referred to the living species *Botryococcus braunii* Kützing. It has a variety of names based on fossil specimens, the oldest (from Esthonia) dating back to the Ordovician. Professor Harris declares that the abundant specimens agree perfectly with the living alga, but with no other organism, and he is not willing to treat them as distinct so long as he is unable to specify any distinguishing characters.

(8) *Fossil Orthoptera Ensifera.* By F. E. ZEUNER. Text pp. 321. Plates lxxx, in separate volumes. 1939. It has long been a reproach to European entomology that the various museums have contained great collections of fossil insects of prime importance for the understanding of the subject, yet almost wholly ignored by the taxonomists. It is difficult to understand why these precious and often beautiful specimens have not attracted many students, while even such papers as have been published have received scant attention. I recall my astonishment when, having found fossil tsetse flies in Colorado and placed a specimen in the Geological Department of the British Museum, I found that a leading authority on living tsetse flies, working in another department of the Museum, had not had the curiosity to look at it. Dr. Zeuner's fine work represents a breaking away from such apathy, and deals in a comprehensive manner with the grasshoppers, crickets and similar insects, having an extended ovipositor in the female. These insects are of great antiquity, and appear to have been the first musicians in the world. Some very striking types, after surviving through millions of years with comparatively little change have died out before the modern period. But the crickets, as we know them to-day, were singing in the forests and fields many millions of years ago, and have undergone no important change in the long interval.

In addition to such monographic or revisional works as are cited above, we have the reports of important expeditions, as follows:

(1) *Expedition to Patagonia and South Chile.* The flies (Diptera) were especially collected, very many new species being found. Part 7, fascicle 3, is before me, partly written by D. A. Hall, of the U. S. Department of Agriculture, and partly by John Smart, of the British Museum.

(2) *Ruwenzori Expedition of 1934–35.* This was a botanical-entomological expedition to the high mountains in the vicinity of the great African lakes, with F. W. Edwards and G. Taylor, of the Museum, as leaders. It was supported by grants from the Percy Sladen and Godman funds, the Uganda Government and Mme. de Horrack Fournier. Three volumes on the insects have been coming out in parts, each devoted to some special group. The first has to do especially with the blood-sucking flies; the second with other flies, and the third with various insects, including butterflies, caddis flies and fleas. The authors are mostly British, but one lives in Germany, another in Australia. The illustrations are numerous and excellent.

(3) *Great Barrier Reef (Australia) Expedition of 1928–29.* This has to do with marine life and the vari-

ous parts, though dealing with a remote region, are of great interest to American students. This will be understood from the citation of some of the titles, such as: Rock-destroying organisms in relation to Coral Reefs; The Zooplankton; Copepoda; Larvae of the Decapod Crustacea; Mollusca (a very large report, of which part 1 has appeared).

(4) *The John Murray Expedition of 1933–34.* Five volumes have been appearing in parts. The region surveyed was the Indian Ocean and the Gulf of Aden, full use being made of the echo-sounding machine, which made possible the detailed mapping of the ocean floor. In addition to the purely oceanographic work, very large collections of the marine animals were made, and I have before me detailed reports on such groups as the Cirripedia, pelagic Hemiptera, Pennatulacea, Amphipoda, Scyphomedusae, Polychaeta, Asteroidea, Phyllirhoidae, Pteropoda, Penacidae, Opisthobranchia, Astacura and Palinura, Pycnogonida and Corals.

The above account does scant justice to the activities of the British Museum, but the reader will get some idea of the volume of the work and the liberal policy with regard to publication. As I write, the news from Europe is extremely discouraging, and it is to be feared that the torch of science, if not extinguished, will be so dimmed as to shed little light or will blaze anew in creating means of destruction. Progress in human affairs, within the period of my recollection, has been so great and in most respects so admirable that it is hard to understand how any reasonable individual or group of individuals can fall under the influence of social pathology, nullifying the good that has been done, and might so easily continue in ever-increasing volume. The return to social health and sanity will no doubt eventually occur, but how soon and in what manner? In the meanwhile, scientific workers will carry on as circumstances may permit.

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# SPECIAL ARTICLES

## NOTE ON WATER IN NON-AQUEOUS SOLUTIONS

IN various models designed to imitate living cells the cell surface is represented by guaiacol, which acts very much like certain protoplasmic surfaces. In such models the behavior of water presents interesting features and it is desirable to ascertain to what extent they occur in the living cell.

The following example serves to illustrate the situation. To a two-phase guaiacol-water system at equilibrium at 25° C. we add increasing amounts of trichloroacetic acid and find that the concentration of water in the guaiacol phase steadily increases while its activity in this phase decreases.[1] When its concentration has increased 12 times its activity coefficient falls to less than 1/12 of its value before acid was added.[2,3] This indicates an attraction of the acid for the water.[4]

At the same time the activity coefficient of the guaiacol in the aqueous phase falls off nearly as much, indicating an attraction of the acid for the guaiacol.

Since the acid can attract both water and guaiacol it is able, when added in sufficient quantity, to make the two phases fuse into one.

A number of other systems follow this pattern, as is evident from the literature.[5] Substances which act like trichloroacetic acid (in other systems) are other organic acids, lower alcohols, acetone, phenols, aniline hydrochloride and pyridine.[5]

Trichloroacetic acid in diffusing through the guaiacol phase appears to carry water with it. Water moves from an aqueous solution where the concentration, mole fraction, vapor pressure and activiity of water are low to one where they are high. A variety of factors must be considered in this connection.[4]

One interesting feature is the following. Let us suppose that a diffusion cell is set up and that the diffusion reaches a steady state so that the concentration gradient of acid in the guaiacol phase may be represented by a fixed straight line, as in Fig. 1.

We may then represent the concentration gradient of water as in Fig. 1, since it is obvious in shaking experiments that for each concentration of acid there is a definite concentration of water.

The concentration gradient of acid is due to flux of acid, but that of water need not be due to flux of

[1] This is shown by the fact that as the guaiacol phase takes up more water it comes into equilibrium with a series of aqueous solutions with decreasing vapor pressure of water.

[2] The activity coefficient of water in the guaiacol phase before acid is added may be regarded as $f_w = a_w \div c_w$ where $a_w$ is the activity and the $c_w$ the concentration of water in the guaiacol phase. When acid is added the vapor pressure of the water in the guaiacol phase, $p_w$, falls to $p_w\ (x)$, where $x < 1$. When enough acid has been added to raise $c_w$ to 12 $c_w$ and to lower $a_w$ to $a_w\ (y)$, where $y < 1$, and $f_w$ to $f'_w$ we have $f'_w = a_w(y) \div (12c_w)$.

[3] We have been unable to find similar calculations for other systems in our preliminary exploration of the literature, but data exist which might be employed for this purpose.

[4] This will be discussed in a forthcoming article in the *Journal of General Physiology.*

[5] *Cf.* "International Critical Tables," 3: 398 *ff.*, McGraw-Hill Book Co., Inc., New York, 1928, where various diagrams show that as the non-aqueous phase (which is not guaiacol) takes up more and more water it comes into equilibrium with aqueous phases containing less and less water just as in the guaiacol-water-trichloroacetic acid system.