ments[5] carried out with a much more massive screen (9603 Kg. lead instead of 104 Kg. mercury) apparently finds an absorption coefficient of only one-third the value given by his earlier experiments. The actual difference in weight found was only 0.002 milligram. In view of the extremely small quantity to be detected and the large amount of evidence against the existence of such an effect, it may be fairly assumed that Majorana's result is in error.

PAUL R. HEYL

BUREAU OF STANDARDS,
WASHINGTON, D. C.

SCIENTIFIC BOOKS

A Study of Some Social Beetles in British Guiana and of their Relations to the Ant-plant Tachigalia WM. M. WHEELER. Zoologica, Dec. 24, 1921.

Five Years' Observations (1914-1918) *on the Bionomics of Southern Nigerian Insects, chiefly directed to the Investigation of Lycænid Life-histories and to the Relation of Lycænidæ, Diptera and other Insects to Ants.* CHARLES O. FARQUHARSON. Trans. Entomological Society of London, 1921. (Published January, 1922).

THERE are many excellent reasons for the study of insects. They constitute the majority of living animals, so far as at present known; and in their relations to one another and to the environment present biological complexes the analysis of which tests the powers of the keenest observers. We go to the Protozoa to find the problems of heredity and environment reduced to the simplest terms; but we turn to the world of insects to learn what life can do in developing the most intricate, diverse, and many-sided adaptive mechanisms and habits. It may be said that the most elaborate poem consists of nothing but letters of the alphabet, and in the same sense all the phenomena of insect life are implied in the simpler reactions of unicellular animals. But after all, the poem is very much more than letters or words, and the biologist who tries to express the masterpieces of vital activity in terms of simple and universal reactions can only do so by shutting his eyes to the real nature of the phenomena. It is, in fact, necessary to look in two directions at once; to be equally alert to detect general laws or principles, and to perceive special cases, which in a real and significant sense are unique.

Not only do the insects thus illustrate the wonders of life, but they afford us excellent material for evolutionary studies, whereby we may eventually understand in some measure how the most complex structures and reactions arose. They do this because the species are so excessively numerous, and there is every reason to suppose that much of their evolution has been *lateral;* that is, by the development of segregates without the disappearance of the original stock. Thus it may well happen that a sufficiently extensive collection will show a series of forms, along with their prototypes, the latter still existing under the original conditions. Recent studies have revealed the existence of many slightly divergent races or species, more or less different in their adaptations and reactions, exposing the very mechanism of evolution to our view. These phenomena, read in the light of the remarkable genetic studies on *Drosophila* and other insects, begin to acquire extraordinary significance and interest. It must further be said, that if we are to take full advantage of the wealth of biological opportunity afforded by the insects, we must turn to the tropics, where the number and diversity of species is at a maximum. In the tropics essentially similar climatic conditions have persisted for ages, permitting the development of biocoenoses which may be compared with old and highly diversified civilizations. But the detection and analysis of these requires resident study or permanent stations, as the English naturalist, A. R. Wallace, long ago insisted. Expeditions, traveling rapidly over the country, appear more adventurous or romantic, and often return with very large collections; but any one who has occasion to study the specimens so collected, must keenly realize the lack of biological information.

For all these reasons, the Tropical Research Station in British Guiana, established by Mr.

[5] *Comptes Rendus,* 173: 478, 1921.

William Beebe, is certain to become classical ground. Not only is the station most favorably situated for research, but it is securing the interest and cooperation of some of the most brilliant American naturalists. Although much work has already been done, it represents no more than a minute inroad on the resources of the locality. But whatever may be accomplished hereafter, it will not often happen that any more interesting story will be written than that by Dr. W. M. Wheeler on the insects associated with the plant *Tachigalia*. This genus of leguminous trees has long been known to harbor ants within the enlarged and hollowed petioles. The very name of the genus was derived by Aublet (1775) from the native name indicating this association. Dr. Wheeler, in the short time at his disposal, was able to detect no less than 50 species of organisms associated primarily with the leaves or terminal shoots of the plant, or secondarily with the organisms thus associated. Twenty-eight of these were ants, half of them representing new species, subspecies or varieties. The others included various kinds of insects, seven of which proved to be undescribed, and have been discussed in short supplementary articles by a number of specialists. The regular or normal inhabitants of the petioles are certain ants, beetles and coccids. The ants comprise two species of *Pseudomyrma* and two of *Azteca*. The coccids are all of one species, identified as *Pseudococcus bromeliæ* (Bouché)[1]. The beetles have been described by Messrs. Schwarz and Barter, of the U. S. National Museum, and are found to represent two species of Silvanidæ, one of them so remarkable as to be placed in a new genus. The discussion centers around these beetles, which prove to have very singular habits. Both adults and larvæ feed on the parenchyma of the *Tachigalia* petioles, but they also solicit and drink the sugary excrement of the coccids. When a beetle finds a coccid, it proceeds to apply its antennæ to the rounded surface of the mealy-bug's back, like "an expert pianist moving his hands from side to side over the key-board, or a masseur with his hands in soft gloves, massaging a patient." The beetle may spend as much as forty or more minutes in this operation. If the coccid is in the proper condition, it discharges a drop of liquid, which the beetle at once greedily swallows. The beetles do not seem to be able to judge whether the coccid is capable of responding, and will work for long periods without getting any results. Not only do the adult beetles behave in this manner, but the larvæ also solicit food from the coccids. Dr. Wheeler not only describes the interrelationships of the various insects in considerable detail, but gives a most interesting discussion of the general problems of instinct and habit involved; a discussion which has the advantage of being based on a minute knowledge of actual facts, rather than general presumptions as to what ought to be true. This discussion ends with a speculative passage which can not fail to attract the reader's attention.

"Fouillée believes that every appetition involves a rudimentary cognition and that automatic behavior like that of the habits and reflexes is merely lapsed appetition. If it could be shown that the latter really can have this derivation and that such ontogenetic mechanisms as habits can acquire representation in the germ-plasm and hereditary transmission, we might be in a position to give a consistent account of all animal behavior, and one which would lead us to regard the reflexes and the tropisms as ultimate, highly specialized end-stages instead of primitive, elemental components of behavior" (p. 118).

Charles O. Farquharson was trained in the University of Aberdeen, and went out to Nigeria as government mycologist. Through Dr. W. A. Lamborn, entomologist at the same station, he became interested in insects, and both men were greatly stimulated by Professor E. B. Poulton of Oxford, with whom they constantly corresponded. Owing to conditions arising out of the war, Farquharson was obliged to spend

[1] Bouché's description, quoted by Signoret, is partly inaccurate, and may not refer to a *Pseudococcus* at all. The current identification of the species is traditional, and probably cannot be justified or confirmed. The "*P. bromeliæ*" found on pineapples in Florida (Quarterly Bull. State Plant Board of Florida, October, 1917, p. 47) is almost certainly *P. brevipes* (Ckll.), and cannot be Bouché's species.

much of his time in doing routine work unconnected with sciences, but he managed to make a great number of interesting observations, which he hastened to communicate to Professor Poulton in letters, along with specimens of most of the species referred to. He hoped, on returning home, to work up his results and publish his more important discoveries, but he lost his life through a collision at sea within a few hours of Liverpool. Professor Poulton has edited his letters, adding a brief memoir and numerous notes, together with a series of contributions, from specialists, describing many of the new or interesting species found.

The paper is so long, and its contents are so varied, that it is impossible to give an adequate summary. The principal section, however, refers to the transformations and habits of a number of species of Lycaenidae, and brings out a number of new and curious facts. It is a strange coincidence, that almost simultaneously with Dr. Wheeler's publication of the observation of beetles obtaining liquid nourishment from coccidæ in South America, Farquharson's account of similar habits in Lycænid butterflies in Africa appears. The butterfly concerned is *Teratoneura isabellæ,* a long account being given, showing that the attending ants are driven away, apparently by flapping the wings. Professor Poulton suggests that an offensive odor is also produced. Later, two other related butterflies, of distinct genera, were found to have the same habits. Unfortunately the coccids were not preserved, and we can only conjecture that they were some species of *Pseudococcus.* Both of the works reviewed were capable of being completed only by the cooperation of rather numerous specialists, entomologists and botanists. It becomes increasingly evident that much of the best work in bionomics must necessarily be cooperative, no single individual, however learned, being capable of dealing with all of the species and problems involved. It is pleasant to find, in the papers before us, that the desired assistance was freely given and is completely acknowledged. Only in this spirit is it possible for men to work harmoniously together, and any who fail to conform to proper standards should be made to feel the disapproval of their colleagues.

T. D. A. COCKERELL
UNIVERSITY OF COLORADO.

SPECIAL ARTICLES

SEALING TUNGSTEN INTO PYREX

THE author has spent considerable time in evolving a good method of sealing tungsten wire into Pyrex and fastening the copper lead-wires to the tungsten. The method here described is easily accomplished and the freedom from breakage is certain. It is hoped that the present detailed description may save others sufficient time to justify its publication. An elementary knowledge of glass-blowing is assumed.

The sealing-in glasses and the order of joining are:

tungsten—G705H—G702P—Pyrex.

The numbers are used by the Corning Glass Company to designate these glasses. Some glass-blowers prefer to omit G705H and seal the tungsten directly to G702P. The G705H is of lower melting point, may be used in the gas-air flame and hence offers less chance to oxidize the tungsten.

Clean the wire by sandpaper only or warm in the flame, dip in a saturated aqueous solution of sodium or potassium nitrite (or nitrate) and then polish with very fine sandpaper or even the thumb nail. Draw small tubes of each of the three kinds of glass having an internal diameter slightly larger than the diameter of the wire. Cut a short length from each and string them on the wire in the order (above) in which they are to be sealed. The flame should be applied first to the middle of the G705H bead and the others in turn be brought along the wire and melted to the preceding one. The wire with its glass coating, Fig. 1-a, may then be sealed in in the usual manner but joining Pyrex to Pyrex. In case the tungsten wire is small and it is desired to protect it from the flame the Pyrex enclosing tube may be extended through the final seal, Fig. 1-b, and the excess glass broken off after the seal is accomplished.