different size and shape and possesses important differences in nearly all parts of the plant, the discrimination against the foreign pollen is very pronounced. The result is almost complete non-functioning of the pollen from the dissimilar plants although such pollen when acting alone is capable of normal fertilization. The greater genetic diversity of these two types is also indicated by the fact that the amount of heterosis shown in the increased weight of the crossed seeds is much more than in the previous case of the similar varieties.

There is here exhibited the working of a tendency which acts to set individuals apart. Besides *Zea mays* three other species, representatives of different orders of the two main classes of angiosperms, show the same phenomenon. It is paralleled in the assortative mating of animals from the lowest to the highest. It is not inconceivable that when carried far enough there may be created an impassable physiological barrier separating different groups. As far as can be judged the differences shown by the types used for illustration are the usual qualitative and quantitative characters which we have been thinking of in terms of Mendelian units. Such hereditary characters may not be directly concerned with the selective action but may be merely associated with differences in more fundamental qualities, but whatever these are they are transferable.

Of course this tells us nothing as to how the differences which are correlated with inequality in fertilizing ability arose. But however diverse were the forms which entered into the ancestry of maize they must have been sexually compatible. Individual members of this species which are quite diverse in form and behavior are now showing a marked tendency towards sexual incompatibility. The degree of selectiveness may be no greater now than it was when the species was first founded but the fact that there is a condition of measurable physiological aloofness is reason to suppose that the accumulations of characters of the same order would culminate in different groups being clearly set apart. Given sufficient time specific differences may finally result.

D. F. Jones

Connecticut Agricultural
Experiment Station

GRAVITATIONAL ABSORPTION

The experiments of Majorana[1] on gravitational absorption having attracted considerable notice, it seems well to direct attention to the large amount of experimental evidence to the contrary.

Russell[2] in a recent article has shown that astronomical and tidal phenomena would limit any gravitative absorption to one-thousandth or less of the amount announced by Majorana.

Eichelberger and Morgan,[3] of the U. S. Naval Observatory, have recently published the results of clock observations from 1903 to 1911, reduced so as to show a difference, if any, between the day and night rate. It appears from these results that such a difference can not exceed 0.005 second, about one-tenth that previously announced by the Lick Observatory[4]. The writer is verbally informed that the Naval Observatory results from 1913 to 1918, reduced but not yet published, bring this slight difference to a still smaller figure.

The existence of gravitative absorption should cause a pendulum clock to run slower by night than by day, on account of the absorption by the earth of the gravitative action between the pendulum bob and the sun. Taking Majorana's coefficient of absorption (6.7×10^{-12}) the average absorption of gravitation by the earth during the night would amount to about three per cent. of the solar gravitative acceleration at the distance of the earth, which is about 0.0006g. The total gravitative acceleration to which the pendulum bob is subjected would therefore be reduced at night by about 0.00002g, or 2 parts in 100,000, and the average time of swing increased by 1 part in 100,000.

Taking 0.005 second as the greatest permissible change in 12 hours, the observations of Eichelberger and Morgan would limit the change in time of swing to something like 1 part in nine million.

Majorana himself, in a later series of experi-

1 *Phil. Mag.*, 39: 488, 1920. *Atti della Reale Accademia dei Lincei*, 28, 1919, and 29 1920.

2 *Astrophysical Journal*, 54: 334, 1921.

3 *Astronomical Journal*, No. 795, January 1922.

4 *Lick Observatory Bulletin*, No. 330, April, 1921.

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.