length of training, and improvements of work methods and conditions.

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HOW BIG IS A CELL?

IN classes in elementary biology some attempt is usually made to relate the world revealed by the microscope to the world as we know it with our unaided eyes. In these attempts it has been particularly difficult to compare the scales of the two worlds. For the comparison one needed an every-day object large enough to come within the range of a microscope's field of view. In teaching a class in elementary botany, it occurred to me that the thickness of a page in a book might be so used. The students were asked to determine the figures for themselves, by measuring the thickness of 100 pages of an actual book, dividing by 100 to obtain the value for one page, and then multiplying by 1,000 to convert the reading into microns. Most text-book paper is around 50 microns thick.

In one laboratory course the idea was pushed even further and the students were required during the first exercises with the microscope to rule their drawings with faint lines, 55 microns apart in the scale of the drawing. The finished work then showed what the cells in question would have looked like if seen against the ends of pages in the text-book. I can not be sure that all this was much help to the students, but I have found from experience that it has been very useful to me. Not only has it helped to relate more effectively the two worlds in which I spent most of my time, but it has given me a much better working knowledge of the relative sizes of different plant cells.

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SCIENTIFIC BOOKS

Halley's Comet in its Appearance of 1909–1911. By NICHOLAS T. BOBROVNIKOFF. Publications of the Lick Observatory, Vol. XVII, 309 to 482, 1931.

EVERY one interested in comets to the slightest degree knows of the important papers already published by Bobrovnikoff upon this subject. It is therefore no surprise to find this last perhaps the most complete study of a comet's appearance that has ever been published. Its length and the great detail in which the author describes striking phenomena are justified both by the importance of Halley's Comet, as a typical comet and historically, and by the wealth of data at his disposal.

Working at the Lick Observatory, he used as the basis of his discussion the 438 plates of the comet secured there and 271 selected reproductions from plates taken elsewhere. The former were taken mostly by Dr. Heber D. Curtis, with the writer of the present review much of the time as his assistant. Curtis had intended to work up these himself, but the opportunity for fully doing so never came, though he did publish a preliminary paper (Pub. A.S.P., 22, 117, 1910), and made a number of calculations and notes for the longer one. Therefore Curtis generously turned over everything to Bobrovnikoff, who has, here and there, used some of these calculations in his discussion.

In the space available here, one can call attention to but few of the salient points among the great number of interesting conclusions. The nucleus is proved to have exerted appreciable repulsive forces upon matter forming the jets; in it, however, no rotation was shown, and on several occasions changes of an explosive character were detected therein. For instance, on May 24 a five-fold increase in its size was noted during the exposure of one plate. The threatened breaking up, however, was always followed by a collapse. The jets, composed of cyanogen, were actual matter being expelled. For those in the prolonged radius-vector the nucleus showed repulsive forces of from 1 to 6 times gravitation. The envelopes, in the forms of approximate catenaries, expanded outward at the rate of about half a kilometer per second. The velocity of expansion of the halos was of the same order.

A new determination of the mass of the comet comes out to be of the order of 10^{-10} that of the Earth. This confirms the growing conviction of many of us that some older estimates of the masses of comets were absurdly low. The tail of the comet proved to be double, Tail I having a slight departure from the prolonged radius vector of the orbit, but Tail II making an angle of about 40°. Apparently CO^+ was the chief constituent of Tail I, Tail II shown by diffused solar light and to a lesser degree also by the light of glowing CO^+. In I, the average repulsive forces ranged from 10 to 20, but for the condensations in I these numbers increased to from 20 to 150; in II they were in general < 0.3. He concludes, therefore, that, while the Bessel-Bredichin mechanical theory of comets' tails is sufficient to explain the observed facts, the latter's actual classification is inadequate and that at least four classes are needed, with a great extension of his ideas as to the maximum magnitude of the repulsive forces. It was further shown that not only

the nucleus but even knots in the tails were centers of separate activity and repulsive forces, and finally that the assumption that a mass in the tail moves in a hyperbola is only a first approximation; its actual motions seem to be along a series of short paths, under varying repulsive forces.

Only a few trifling typographical errors were detected. The printing is exceptionally good and, for a technical paper, the style is easy and the statements and conclusions clearly made. As a masterly summary of everything that was learned or inferred from the last visit of Halley's Comet the memoir can be highly recommended to every one. It leaves us, however, realizing more than ever how incomplete is our knowledge of the forces acting within a comet and of how evolution ever formed bodies of this type.

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The Insect Menace. By L. O. HOWARD. Pages i–xv, 1–347, numerous text illustrations. The Century Company, New York, London, 1931.

THIS is a very readable, interesting account addressed primarily to the thoughtful general public, in spite of the apparently sensational title. The latter is justified by the facts, though comparatively few realize this. There surely is a menace in a group of animals indirectly causing deaths of millions of human beings by disease and starvation. Insects have depopulated considerable sections of the earth and are still maintaining supremacy in certain areas. They certainly can be considered menaces to human welfare.

The author has made a serious effort to interpret to mankind the insect world from the historical or geological, biological and economic aspects, using these terms in a broad sense. This is not a mere discussion of man's history of insects. It outlines the development of this enormous group over a period of forty million years or more and possibly through three hundred million generations, and compares this with the existence of man, extending over some four hundred thousand years and comprising possibly twenty-four thousand generations. It is said that blood tells. Here is a breeding record which shows man as an egotistical upstart, as compared with the earlier, the much more numerous insect dwellers of the earth. In other words, millions of years of existence, the myriad adaptations and the tremendous number of species in all parts of the earth in almost all types of matter clearly demonstrate the ancestral and biological superiority of insects which we, as humans, affect to despise. The evidence forces us to concede biological supremacy to the supposedly lowly insects. The author dwells upon the advantages of the resistant, somewhat elastic, outer walls, known as the exoskeleton to the scientist, calls attention to the great adaptability of insects and also to the extreme prolificacy of these numerous friends and enemies of mankind. In this portion of the book we find many extremely interesting records, not a few of which are relatively new, even to professional entomologists. The book is a remarkable contribution to popular literature on the status of insects and by an outstanding authority in his chosen field. The touch of a master hand and the influence of a broad general knowledge are evident throughout the work.

The problem confronting man, or practical control, is discussed in a comprehensive and extremely interesting manner. Occasional pictures of the experiences of early inhabitants of this country with insects are illuminating and add much to the text. The writer's fifty odd years' experience as a leading economic entomologist in America, in fact in the world, enables him to select the most striking examples of wide-spread depredations, and even death caused by insects. He is better equipped than many another to discuss the basic principles which should be observed in the selection of means for controlling these nefarious and, in some cases, omnipresent pests. There is an interesting and intimate account of the development of quarantine restrictions, with striking sidelights upon the difficulties of enforcing such regulations. There is a discussion of the possibilities and limitations of spraying and the potentialities of biological control. This last appeals greatly to the popular imagination, since it means using insects to kill insects, a subject which is deservedly receiving a great amount of attention at the present time. A distinctly human interest story is related in the account of a search for parasites of the notorious gipsy moth. We find romance in science as well as unselfish devotion to investigation.

There are suggestive accounts of three outstanding efforts to control insects in this country. These deal respectively with the Rocky Mountain locust or Western grasshopper, one of the most terrible pests of the earlier days and even now extremely destructive occasionally, the cotton boll weevil, an outstanding pest in the South in spite of the monument which has been erected to its honor, and the more recent Mediterranean fruit-fly, an introduced insect generally brought to public attention by the press in the last few years on account of its having been discovered in Florida. The excellent series of well-selected illustrations add greatly to the value of the text.

The writer's long experience as a leading economic entomologist and his intimate contacts with leaders in all branches of natural history have enabled him to effectively levy on much general literature usually ignored by specialists, and to cull from such works