factors should be of especial importance in the lubrication of motors, flying-machines, automobiles and similar machines.

The work is presented in regard to paper and printing with the characteristic skill and care of the German publisher, and with the patient thoughtfulness on the part of authors and publisher that we are led to expect in German publications.

Charles F. Mabery

Applied Biology. An elementary text-book and laboratory guide. By Maurice A. Bigelow, Ph.D., Professor of Biology in Teachers College, Columbia University, and Anna N. Bigelow, Teacher of High School Biology. 8vo. Pp. xii + 583. New York, The Macmillan Company. 1911. $1.40 net.

Teacher's Manual of Biology. A handbook to accompany the preceding. By Maurice A. Bigelow, Ph.D. 8vo. Pp. viii + 113. New York, The Macmillan Company. 1912.

Readers of Science have sometimes been entertained by bursts of eloquent disapproval of all courses in general biology. Certain noted botanists especially have been wont to speak of such courses as impossible, decadent, reprehensible; as maladies of a peculiar American epidemic, that has, happily, long since run its course. Their ills have been solemnly charged against presumptuous zoologists who have rushed in where modest botanists fear to tread. Fie on any one who would teach about plants and animals in the same course!

This protest has been loud—perhaps a bit too loud; for certain it is that courses in general biology were never so widespread as at the present time, nor were there ever so many new text-books offered for such courses, not only in America, but in Germany and France as well. Perhaps the reason lies in a permanent educational need, which such courses fulfill. There are those who have tried to test the matter by scientific methods who think so.

Among the many new books offered in this field is an important one by the Bigelows for secondary schools. Its title is "Applied Biology," but, fortunately, the applied part of it is mostly in the title. It would be an important book, if for no other reason, because it represents a great deal of honest effort on the part of competent teachers of extensive and varied experience, to put together into one consistent course what they deem best of all that they have tried. One does not need to be committed wholly to its plan in order to agree that it has been carefully laid out, and based on long experience and good judgment.

It is a conservative book. It begins with a chapter on definitions and another on the distinctive characteristics of living things (22 pages). Then follow chapters on the frog and the bean plant, these two types serving as an introduction to animal and plant biology respectively (122 pages). Then follow the more customary series of plant and animal types, the plants in descending, the animals in ascending series (300 pages), leading to a concluding part devoted to the consideration of the principles of biology as applied to human structure and life (118 pages). In all this there is much careful culling of both subject matter and methods: and a well-balanced indoor course for city schools is the result.

The biology taught is distinctly that of the laboratory—not of the outdoors. While there are here and there hints of the existence of outdoor biological phenomena, there is no plan provided for the study of them.

The technical terms used are few, but adequate. One notes almost with surprise how great is the gain resulting from the omission of most of the rubbish of terminology that encumbers the average high-school text. Of more doubtful value is the relegation of most of the laboratory work to demonstration by the teacher. Though this saves time and yields fewer failures of individual experiments, one may well doubt whether the pupil will learn, by handling pen and paper and recording results, what the handling of the things would teach him.

The illustrations are old—some of them so old that the original sources appear to have been lost. The authors seem to think that "well-known figures from standard biological works are to be preferred to new ones." At least, they are cheaper. One notes with regret the perpetuation of the grossly inaccurate fig-

ure of a mayfly nymph (from Parker & Haswell) on page 399; also the confusion of the lettering in figure 32 on page 79 (from Bessey), and the use of the word ovary with very different meaning in this figure and in one on page 244.

Biological pickles do not seem, as a rule, to excite much enthusiasm on the part of a beginner of high-school age and exception may be taken, therefore, to the suggestion on page 389 that for practise with insects "a mixed lot preserved in wood alcohol or formalin is best." But, as a rule, the suggestions as to laboratory methods are excellent and the book, as a whole, is a valuable contribution to the literature of biological laboratory methods.

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THE SO-CALLED AEROSTATIC HAIRS OF CERTAIN LEPIDOPTEROUS LARVÆ

IN his valuable report on the dispersion of the gipsy moth,[1] Mr. A. F. Burgess emphasizes the very great rôle which is played by the wind in distributing the first-stage caterpillars. In this connection he calls attention to, and figures the so-called aerostatic hairs arising from tubercles in first-stage larvæ of the gipsy moth, though he does not commit himself to the theory that they, with their globular swelling at the base, actually aid in making the caterpillars more buoyant.

These peculiar hairs, to be found on first-stage larvæ of the nun moth, as well as of the gipsy moth, were first described by Wachtl and Kornauth[2] under the name of aerostatic setæ, while they designated the balloon-shaped swellings as aerophores. They have been subsequently noted by several workers.

As indicated by the name, the aerophore was supposed to be filled with air, and Wachtl and Kornauth believed that the aerostatic bristles presented a collection of balloons which function as an aeronautic apparatus. If their interpretation be correct, it is obvious that in both the nun moth larvæ and in the gipsy moth larvæ these structures play a very important rôle in aiding the dispersal of the species by the wind.

Those who hold to the view that the swellings are in reality aerophores have not sought to explain how it is that the almost microscopic structures should serve as "balloons" if they are filled with air. A balloon rises because it is filled with gas lighter than air. To be sure, Fernald[3] suggests that they are distended with air "or gas," but it is difficult to conceive of a possible source of a special gas.

Apparently, Professor Cholodkovsky was the first to suggest the true nature of the so-called aerostatic hairs. First, in a Russian forestry journal and then in Tubeuf's *Zeitschrift*[4] he called attention to certain serious objections to Wachtl and Kornauth's hypothesis. The fact that the swellings, or vesicles, shrink in dead larvæ, militates against the view that they are filled with air. On the contrary, it favors the view that they contain a fluid which, after the death of the larvæ, naturally must dry up. In larvæ preserved in alcohol, air-filled organs would soon lose their air content, but these vesicles remain for months as full and rounded as in the living larvæ. If such a preparation is allowed to dry on the slide all of the "aerophores" quickly shrivel.

Cholodkovsky, therefore, suggested that the swellings were not filled with air, but with a fluid, and that very probably this was a poisonous one, since the larvæ, in this stage especially, need protection against insectivorous birds. This view was confirmed by the study of sections, which showed a large, unicellular gland underlying each of the "aerostatic bristles" and opening directly into the cavity.

[1] Bull. 119, Bu. Ent., U. S. Dept. Agric., February, 1913.

[2] Wachtl, F. A., und Kornauth, K., "Beiträge zur Kenntniss der Morphologie, Biologie und Pathologie der Nonne (*Psilura monacha*)," Mittheilungen aus dem forstlichen Versuchsvesen Oesterreichs, XVI., pp. 1–38, 1893, 3 pls.

[3] Rept. on the Gypsy Moth, Mass. Board of Agr., 1896, pp. 300–301.

[4] Cholodkovsky, N., "Ueber die sogenannten Aërophore der Nonnenraupe," *Forstlich-naturwissenschaftliche Zeitschr.*, III., pp. 240–243, 1894.