

be produced as readily as the illusions connected with a square within a square. A certain distance for a point of observation and also a certain speed of rotation appears to be necessary, for fans nearer the observer rotating more slowly do not produce the phenomenon which now seems to be due to the same principle of accommodation that makes a figure of a square within a square appear at one time as a hollow space and at another as a solid.

Two other illusions connected with the fan, but which may be well known to every one who has watched moving machinery, may be noted. In one the vanes, instead of rotating, seem to flap together; in the other the two iron arms appear to be continually withdrawing into and pushing out from the hanging rod.

F. C. KENYON.

#### SCIENTIFIC LITERATURE.

*Plant Life, Considered with Reference to Form and Function.* By CHARLES REID BARNES, Professor of Plant Physiology in the University of Chicago. New York, Henry Holt & Co. 1898. 12mo. Pp. x + 428.

In his preface the author says: "The absence of an elementary account of the form and functions of the plants of all groups has made itself felt," and "I am not aware that any book at present attempts to meet this need." These sentences, coupled with the author's reference to secondary schools, and to pupils of thirteen to eighteen years of age, indicate the purpose and place of the book.

In carrying out his plan he has divided the subject into four parts, viz.: (1) the vegetative body; (2) physiology; (3) reproduction, and (4) ecology. In the first part appear such chapter headings as 'the unit of structure,' 'single-celled plants and colonies,' 'linear and superficial aggregates,' 'the thallus of the higher algæ,' 'the fungus, body of hyphal elements,' 'liverworts and mosses,' 'fern-worts and seed-plants.' A few years ago such an approach to what was then called 'morphology' would have horrified the old-time teachers of elementary botany, who were anxious to give the study as much 'practical' value as possible, and were wont to repeat pedagogical platitudes as to the necessity of 'proceeding from the known

to the unknown.' Ignoring such objections, the author leads the pupil, chapter by chapter, from the relatively simple plant-body of the fission algæ to the highly complex structures, roots, stems and leaves, of the seed plants. The significance of the latter is thus made much clearer than by the old method of studying the anatomy of flowering plants first, and then following with something of the lower forms from which they sprang.

The treatment of the physiology of plants is satisfactory, as a matter of course, since the author has given especial attention to this department of botany. In the introduction some clear and useful definitions are given; then follows a suggestive chapter on the maintenance of bodily form, one on nutrition (particularly well done), one on growth and another on the movements of plants.

The chapters relating to reproduction must be very helpful in giving the beginner right notions as to how plants provide for a succession of individuals. Old-fashioned people will open their eyes when they find the 'flower' discussed in the chapter treating of vegetative (*i. e.*, asexual) reproduction, along with 'fission,' 'budding,' 'spores' and 'brood buds.' The 'flower' is brought in under the general topic 'spores,' after the discussion has led up to the differentiation of spores into megaspores and microspores. Of course, this is all right, as every botanist knows, but there will be some scrambling and tumbling on the part of many a high-school teacher as he attempts to lead his pupils through this, to him very new, territory, and we imagine that he will fare little better when he comes to the angiosperms in the chapter on sexual reproduction. In order fully to master this matter the teacher will, in most cases, be obliged to spend a term or two in some good botanical laboratory, where he can be helped over the difficult places.

The chapters on ecology are new to American books on botany, and while they are quite elementary they will be useful in the way of directing students and teachers into a comparatively new field of work.

The appendices are in some respects of more value than the body of the book, giving as they do: (1) directions for laboratory study; (2) direc-

tions for collecting and preserving material; (3) lists of apparatus and reagents; (4) lists of reference books, and (5) outline of classification.

Some new uses of old terms are introduced here and there. Thus we have 'ovary' used for oogone, carpogone and archegone, and 'ovulary' for the structure hitherto called the ovary in the flowering plants. 'Sperm' and 'spermary' replace antherozoid and antherid. 'Egg' is consistently used throughout for the female gamete. We do not quite like the use of 'megaspore' as synonymous with 'embryo sac' in angiosperms, and feel sure that it will lead to the confusion of the beginner. It is doubtless impossible to make a clear statement of all the homologies of the gametophyte of angiosperms in an elementary work, but it is certainly not necessary to simplify the statement by running together two structures so distinct as the uninucleate megaspore and the multinucleate embryo sac.

We trust that the author's wish may be realized, namely, "it is greatly to be desired that the too common thought of plants as *things to be classified* may be replaced by the conception of them as *beings at work, to be studied alive*," and we believe that his book will help to bring it to pass.

CHARLES E. BESSEY.

*Grundprobleme der Naturwissenschaft. Briefe eines unmodernen Naturforschers.* By DR. ADOLF WAGNER. Berlin, Gebrueder Borntraeger. 1897. Pp. vi + 255.

The sub-title of this sharp little polemic might well have been *Schopenhauer versus Büchner*. There is much else in the book, but that about it which is most vital is the application of the philosophy of *Welt als Wille und Vorstellung* to such views of nature as characterize *Kraft und Stoff*. But the actual sub-title does very well. 'Unmodern' the author certainly is. *Kraft und Stoff*, his arch-enemy, long ago had its day; and even the aftermath of discussion over Ostwald's Lübeck address, the most modern scientific matter of which he seems conscious, has been garnered in. This is the most obvious fact about the book; it is belated. The ultra materialistic views of nature and the hard and fast notions of matter, atom, molecule,

ether, etc., which the author ascribes to naturalists, are no longer held by them, or are held with a genial flexibility which make the Doctor's savage onslaught seem whimsical.

Then, the book is arrogant in tone. Rarely in these days does the venerable speculative philosophy so lord it over youthful science. Although the book takes the form of letters (in reality a single letter) addressed by a humanist to an old university friend in the other camp, yet the 'lieber Freund,' in spite of the constant 'Du' and 'Dir,' everywhere gets hard blows and short shrift. His views are 'nonsense,' 'absurd,' 'impossible to one who has had a single semester of philosophy,' etc.

And yet it would not be easy to find a better *résumé* of the idealist position with regard to the fundamental problems of nature and science. The book is very readable. It is full of matter. The style is picturesque, lively and popular; the argument clear and mercifully brief. It is a strong book of its kind.

The first half of the book is a coherent argument for a certain view of the world; the second part seems to be occupied (I have not read it completely) with an elaborate *a priori* discussion of the nature of human, animal and plant life. With regard to this part it is only necessary to remark how the philosopher, after belaboring the eternal *is* (the assumption of existence and reality) of science, allows his own equally gratuitous *must be* to run riot. How should it be so difficult to see that we cannot any more get outside and beyond ourselves in philosophy than in science. We project ourselves into our science. Granted. But so, too, we project ourselves into our philosophy, which is, out and out, as truly as science, a creature of taste, mood, temperament, race, age and environment.

What, then, are the 'Grundprobleme?' They are questions concerning the nature of things; concerning criteria of reality; concerning the relation of experience to knowledge. You scientists build upon experience. First find how far experience is valid. You talk of realities. What do you mean by reality? What are your tests of reality?

The author, though everywhere affirming the idealist position, very sensibly refrains from any