and less positive method of presentation would have increased the value of the work.

On the whole, the descriptive portions of the work, covering the morphology, biology, classification, nomenclature and species of parasitic amœbæ, are excellently executed and well illustrated.

A firm belief in the stability of the parasitic species *Entamœba histolytica, E. coli* and *E. tetragena* and the ease with which they may be differentiated on morphological grounds, provided one has studied them long enough, is made evident by the author. In the historical review it is said that Councilman and Lafleur gave "a most excellent description of the parasite now known as *Entamœba histolytica.*" This is done in spite of the admission that comparatively recent researches have shown that species determination must rest mainly upon a knowledge of the reproductive cycle. Again, the author is not very consistent in including in his list of unquestionable species half a dozen organisms the life cycles of which have been only incompletely studied.

No adequate discussion is made of the possible adaptability of amœbæ to a parasitic existence, although on *a priori* grounds one would suspect that some such process might still be taking place in nature. The answer to this question is evidently of the greatest importance from the standpoint of the prophylaxis of amœbiasis. The only extensive experiments made to adapt amœbæ to a parasitic existence have been performed by Musgrave and Clegg in Manila. In criticizing the experiments performed by these investigators the author is rather indefinite and dismisses the importance of their work from the reader's mind by stating that "while lesions were undoubtedly produced by the mixed cultures of amœbæ and bacteria, the authors could not, with their methods, be sure of excluding the spores of *E. histolytica* or the encysted forms of other amœbæ pathogenic to the animals used in their experiments" (p. 63). Later (p. 66) he lays stress upon the feeding of "pathogenic bacteria" along with the cultivated amœbæ—in spite of the fact that it is well known that the typhoid bacillus and cholera spirillum are not pathogenic when fed to the species of monkey used (*Macacus cynomolgus*). Certainly one can not criticize the cultures of amœbæ used by Musgrave and Clegg, for these were the descendants of a single amœba growing in "pure mixed culture" with a single species of bacterium. If it is argued that their animals were infected naturally either before or after the experimental feedings, then it must be shown that spontaneous amœbiasis is of such frequent occurrence in monkeys in Manila as to render these animals worthless for experimental purposes.

Again this state of mind is exhibited in discussing the cultivability of the parasitic amœbæ: "What I have always believed and stated, *i. e.,* that the parasitic amœbæ of man have not been cultivated" as Craig says, he believes to be supported by the recent work of Whitmore, who took cultures he obtained in Manila to Hartmann's laboratory and found them all to be free living species. Yet he makes no mention of the work of Fantham, whose article is quoted in his bibliography, to the effect that, by special cultural methods, he was able to identify two cultures obtained from Manila and kept on Musgrave and Clegg's medium, as *Entamœba coli.*

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BOTANICAL NOTES

Botany by the Experimental Method

A good many years ago some of us introduced to American colleges the laboratory method of learning about plants and this brought about a revolution in botanical teaching mostly for the better, but not wholly without some distinct losses. It is doubtful, for example, whether the pioneers in the laboratory method in this country ever contemplated the total abandonment of field work which followed in some places. It is pretty certain that they intended to *add* the laboratory method to the existing methods of study, which included the textbook, the field and the herbarium. Certain it is, however, that many teachers supposed that the adoption of the laboratory

method was to be followed by an abandonment of everything that had been done in the past. This was a serious error of judgment, and has led to no end of wasteful educational experiments. Because the laboratory method is good in one place is no proof that it is good in all. When I want to learn all that I possibly can of a new country I visit it if I can do so, and see all that I can of it, but I do not hesitate to use maps and read books pertaining to the country. I may even ask the people who have lived there longer than I to tell me all that they know. In this way I build up my knowledge of the country, and it is good and reliable, far more so, perhaps, than if I had relied wholly upon what I could have seen personally.

And so it is in botany. I must surely see as much for myself as possible, but life is quite too short for me to hope to see all that is known with my own eyes. Here and there, at critical and strategic points, I must see for myself and then I can go a long ways, when I must again get my reckoning by an observation. The mariner does not sail the seas by doing nothing but make mathematical observations. It would be slow sailing indeed were he to do so.

And yet this is just what some of the bookmakers are planning to have the children do. They are to learn everything about plants by the experimental method. They lose sight of the fact that there is no special saving grace in the labor of making experiments. We make experiments on plants in order that we may learn botany; we do not learn botany in order to make experiments on plants. Let every teacher remember that useless experiments involve as real a waste of time as dawdling or idling. I *can* walk from Lincoln to Denver, but it takes so much time that it will pay me far better to be carried there on a railway train.

All this is suggested by Mr. Payne's "Manual of Experimental Botany" (American Book Company), whose purpose, the author tells us, is "to teach botany by experiment." In two hundred and twenty-eight "experiments" and "exercises" the pupil is led over and into and among a great many facts pertaining to plants. Some of these exercises will prove to be interesting and helpful to pupils, but there are so many of them that it is quite impossible for the pupil to perform them with any care. It would have been far better to have selected a much smaller number, and to have placed them properly in a scheme outlining the subject. *That* would have introduced the pupil to the science of botany, *i. e.*, to an organized system of knowledge of plants. As it is, the child will have spent a great deal of time and energy in the making of experiments not definitely correlated, nor organized into a science. The pupil will have the results (more or less accurate) of a considerable number of experiments, but they will not constitute botany, that is, the science of botany, and it may be doubted whether in this unorganized form they will have any educative value. It would not be a bad thing to use this book as a store from which to draw such experiments as the teacher and pupil might wish to use in going systematically over the field of botany, although in some cases we must warn the teacher that the experiments will not "prove" all that they are supposed to demonstrate (*e. g.*, 130, 131, 132, 139, 145, 148, etc.). On the other hand, many of the experiments are well planned, and will prove interesting and instructive.

A HANDFUL OF LITTLE MANUALS

IT would seem that the solution of the problem of a handy manual for field work in systematic botany is to be reached by the compilation of little books covering restricted areas, or even confined to limited portions of the year.

Several years ago Professors Clements, Rosendahl and Butters brought out a little pamphlet of 40 pages entitled "Guide to the Spring Flowers of Minnesota," which has been well received by the schools of the state, and to this they have added a "Guide to the Trees and Shrubs of Minnesota," "Guide to the Ferns and Fern Allies of Minnesota" and "Guide to the Autumn Flowers." In the

same series we have also "Minnesota Mushrooms," by Professor Clements.

A year ago A. O. Garrett, of the Salt Lake City High School, published a little book of 106 pages, entitled "Spring Flora of the Wasatch Region," and including "the eastern edge of the Great Basin as far south as Manti" (central Utah). This is now followed with a second, considerably enlarged edition of 139 pages. It must be very useful to pupils in the schools of the region covered. It would be still more helpful if not confined to "spring plants" alone ("before June 15").

Much like the last is the "Spring Flora of the Intermountain States," by Professor Dr. Aven Nelson, of the University of Wyoming (Ginn), which in 202 pages covers Colorado, Wyoming, Montana, Idaho (excepting the northern part), a portion of eastern Oregon and the northern half of Utah. The treatment is much like that in the Wasatch Flora, and must be equally useful in the much larger region included. Here again one wishes that the "spring" limit could be removed.

Hall's "Yosemite Flora" (Elder, San Francisco) is a book designed to appeal in paper, pictures and binding more to the tourist than to the pupils in schools, and yet it must prove a most inspiring field manual for pupils fortunate enough to have access to its keys and descriptions. While called a Yosemite Flora, we are told that it is also "designed to be useful throughout the Sierra Nevada Mountains." Eleven most artistic plates and 170 text figures add much to the usefulness of the book for the beginner.

The "Flora of Nebraska," published by N. F. Petersen, instructor in botany in the Louisiana State University, is an attempt to name every plant (conifers and flowering plants) growing without cultivation in the state. It is modeled after Rydberg's well-known "Flora of Colorado," and like it the treatment is by the copious use of keys, by means of which the phyla, classes, orders, families, genera and finally the species are successively found. And after the species is determined by this method one finds a little paragraph assigned to it containing habitat, distribution and locality data. It will be useful to high-school pupils, in spite of the rather numerous typographical errors, due to the employment of a printer unaccustomed to scientific printing.

Here may be mentioned Professor Schaffner's "Key to the Families of Seed Plants" designed to aid his students (Ohio State University) to distinguish the natural plant families by carefully devised keys.

BOTANY IN THE MOUNTAINS

The University of Colorado Mountain Laboratory at Tolland, Colo., will hold its session this year, beginning June 24 and ending August 2, 1912. There will be a general course in field biology, in which both animals and plants are considered in relation to their environment, and also courses in systematic botany, ecology and biology of ponds and streams. Special attention will be given to research work.

The laboratory is situated in an interesting region at an altitude of nearly 9,000 feet. Tolland is the station for Boulder Park, a mountain valley surrounded by timber-clad hills. Within easy reach of the laboratory are typical pine and spruce forests, mountain meadows, narrow canyons, glacial lakes and alpine tundra. In addition to regular daily field trips which take the student to these various habitats of animals and plants there will be all day excursions by rail to the foothills and even to the plains for the purpose of making comparative studies of the flora and fauna of these localities. Professor Francis Ramaley, of the University of Colorado (Boulder), is the director of the laboratory.

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SPECIAL ARTICLES

NITRATES IN SOILS[1]

The fertilizing value of materials that we now know to contain nitrogen was of course

[1] Paper read by invitation before the Society of American Bacteriologists at Washington, December, 1911.