

conomic interest of the lower orders of vegetable life was not well understood.

It is a source of pleasure to be able to name the common flowering plants, and the practice in analysis is good; but the teacher might better tell the names of the plants and save the time for more important work if the pupil can spend only one term upon the study, and as for the analysis, experience shows that a large part of the work not done under the supervision of the teacher is accomplished by ascertaining the common name and then going to the index.

Some teachers who have followed the old line in elementary botanical instruction will hardly be convinced that other matter should precede. They think that phanerogams are the most noticeable plants and should therefore be studied a whole term even if the lower forms are never known. The fact that they are so noticeable that any one who is really interested and who has had some work in observing and describing phanerogams will learn their names by analyzing, or in some other way, is my reason why the limited time often given to the study should not be devoted exclusively to this class of plants.

Some who have been going on in the old rut will contend that phanerogams were the first plants investigated, and that the order of presentation should follow that of investigation. Let us see. In geology, investigation began at the surface, with the latest formation; but in the study we begin with the deepest stratified rocks, the first formation. In zoölogy the highest forms of life were first studied and first present themselves to the observer, but here again the order of presentation has been changed so that it is the reverse of that of investigation.

However, I think it is not of so much importance where we begin as that we give first a general knowledge of the orders of plants. If those who have been confining their work to flowering plants will give half of it to cryptogams I will not find much fault with them for beginning with the highest order. Yet I think I have proven that the other way is as good without even introducing the principle of going from the simple to the more complex.

Every one who studies botany at all should learn something about bacteria, which play so important a part in our welfare. The same may be said of the economic smuts, mildews and rusts, and many other forms that I need not mention. Vegetable physiology should also form an important part of the work of the first term if it is to be the only one, and the necessary time can be gained by omitting the analysis of so many phanerogams and substituting the examination and description of a plant from each of the more common orders, using the microscope when necessary.

Instead of the old plan I would have all schools, during the first term, take up the orders, proceeding from the lowest to the highest, and close the work with the leading facts of vegetable physiology. I would divide the time equally between cryptogams, phanerogams and physiology. This both gives the best foundation on which to build, and is the most essential knowledge for the student who can not give more time to the subject.

FUNGI VERSUS INSECTS.

BY GERALD MCCARTHYR, RALEIGH, N. C.

DURING the last twenty years the number of species of noxious fungi and insects infesting American fields, orchards, woods and storehouses has increased at a most alarming rate, with a commensurate increase in the damage they inflict. The time was when the substantially complete destruction of any crop by these pests was so rare as to be regarded as a special visitation of Providence. This increase is undoubtedly due to the perfec-

tion of modern commerce, which has made cosmopolitans of species formerly restricted in habitat, and to the opportunity for rapid multiplication that our large solidly planted fields afford. Notwithstanding the vast amount of study which has during the same decades been devoted to these pests and the many different forms of apparatus, formulas and methods which have been devised for combatting them, the damage still done is very serious. In fact intelligent and practical men say that the claims put forth by economic scientists have not been fulfilled. While the copper salts against fungi and the arsenites and kerosene against insects have in individual cases given good results, they have not apparently reduced the numbers of these pests. The use of these substances, too, is not without drawbacks. The acrid copper mixtures often damage the trees or plants nearly as much as the fungi would have done, and fruit plastered with these chemicals does not sell well. To be sure, it is not necessary to plaster fruit with the fungicide, nevertheless it is done, and where spraying is in general use the fruit as marketed is seldom free from its presence. An example of this, which has made a vivid impression upon my mind and stomach, is a lot of Catawba grapes grown near Seneca Lake, N. Y., and sold in Raleigh, N. C. These grapes were considerably spotted with the Bordeaux mixture. As an experiment I purchased and ate a bunch of these grapes, rejecting the skins,—an experiment I am not likely to repeat very soon! The flavor was quite spoiled by the presence of the chemicals, and the effect upon the digestive organs was anything but pleasant. The use of chemical fungicides, like the use of patent medicines for human ailments, has a tendency to cause the user to neglect hygienic precautions, since these latter require more foresight and labor than the former. In spite of all that fungicides have done, the annual losses caused by noxious fungi are still, for the United States alone, \$300,000,000.

The losses occasioned by noxious insects are scarcely smaller. In a single year Illinois has lost \$75,000,000 by the clinch bug and Texas has lost \$20,000,000 by the cotton caterpillar.

The capital fault in all topical treatment of these pests is that it is effective only so far as the treatment goes, and for the time being. Let us suppose A., B. and C. to be neighboring fruit growers. A takes every practicable hygienic precaution by burning all infectious matter, and by cultivation and fertilization stimulates his crops to outgrow their enemies. B has unlimited faith in his "pizen," and applies it with a liberal hand. C is a "one-horse" farmer and has no faith in anything. He lets the bugs alone. The net result is that C grows more fungi and insects than fruit, and enough to devastate his neighbors' crops after his own are ruined. B has bespattered his trees right and left and caused most of the leaves to drop or shrivel up, followed by the fall of the immature fruit. A in spite of all his trouble and expense sees his crop ruined, or if he overcomes his prejudice against the use of chemicals, saves only a part of the crop and that more or less deteriorated. Surely there is something lacking in this method of procedure!

What is wanted is an automatic antipest destroying agent which will do its work quickly, thoroughly and without the aid of such men as farmer B and in spite of such men as farmer C. Such an agent many think we have found in pathogenic, contagious disease producing fungi or bacteria. It is well known to the farmers of the west that in some seasons the swarming multitudes of clinch bugs after devouring the crops disappear suddenly and as if by providential interposition. This disappearance usually follows a period of wet weather and does not as a rule occur until the pests have done irreparable damage and increased until their loathsome presence is

everywhere found. The real cause of this sudden disappearance has been found to be a contagious bacterial disease whose rapid dissemination is favored by wet weather and by the crowding of the insects into restricted areas as the food supply decreases. In this case the disease is left wholly to spontaneous development, but it is reasonable to suppose that were the disease producing bacteria artificially cultivated and multiplied, which is readily done in properly equipped laboratories, and held as a magazine to supply the germs as soon as the first insects are seen, the pests might be swept away, at a merely nominal cost, at the beginning instead of at the end of their destructive career. This is not all theory! In the United States excellent results against the clinch bug have been obtained in Kansas, Illinois and other states. In Europe very satisfactory results have been obtained in combatting the "white grub" (*Melolontha vulgaris*), by means of the fungus, *Botrytis tenella* and *B. bassiana*. In this country the most satisfactory results have been obtained from *Sporotrichium densum* and *Empusa*, several species.

This method of combatting noxious insects is now attracting widespread attention from German and French scientists and promises much for the future.

LETTERS TO THE EDITOR.

*Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

INDUCTIVE PSYCHOLOGY.

I wish to thank you for your appreciative words and criticisms of my "Inductive Psychology," which was hastily prepared for private use rather than to stand the test of criticism for general circulation; I am pleased that more defects are not at once discovered. I think, however, a little explanation from me is necessary upon one point. In writing every sentence of the book my principal question was, what experience of the pupil will this appeal to? what thoughts and observations will it suggest? and not, how can I most logically state these truths so as to completely cover the subject? The aim is not a complete treatment of the science, but an *introduction* to it that shall give the pupil psychological knowledge, power and vocabulary that will enable him to continue the study in both living subjects and books. To such an extent is this true that inferences as to what portions of psychology I value most cannot be correctly made, for my principle of selection was not scientific value and importance but pedagogical value to the pupil at this stage of the study.

Now, Mr. Editor, however much you may disagree with my use of the word "inductive," if you will lay aside the expectations that the word "inductive" in the title aroused in your mind, you cannot but see that the book is pedagogically essentially different in method from any other text-book on psychology. I feel as if explanation on this point is due to myself; for if the book is not different in method of presentation from other psychologies, I have no excuse for writing it. The following, however, from a teacher of psychology, confirms me in the belief that I have such an excuse. "The book is the best I know of from the *teacher's* standpoint. It illustrates a method of treating the subject which I find in no other book. So far as I know, most text-books have been elaborated without regard to the pedagogics of the subject, but only the logical and scientific arrangement of the facts enumerated; but I feel that this cannot be said of yours."

E. A. KIRKPATRICK.

Winona, Minn., Sept. 25, 1893.

THE SOUNDS OF R.

As Mr. Melville Bell complains, in your October number, that the sounds of R have been treated unscientifically in my "Introduction to Phonetics," (Sonnen-schein, London, and Macmillan, New York, 1891), I beg to observe that the difference between us arises from the difference in the facts observed by each.

In my pronunciation, for instance, and in that of cultivated English people of the present day, his ear would, I am sure, observe no difference between *alms* and *arms*, or between *laud* and *lord*.

In my treatment of the *r* sounds in English, I am supported by the evidence of all competent observers of the best English spoken in the south of England in the present day, and the leading phoneticians are also agreed in regarding this as standard English. I refer to such men as Dr. Sweet, Prof. Johan Storm, of Christiania, and Prof. Victor, of Marburg.

If I were making a study of American English it is probable that my observations would be in accord with those of Mr. Melville Bell.

LAURA SOAMES.

Brighton, England.

THE ABSENCE OF AIR FROM THE MOON.

SEEING in the journal *Nature*, of London, date August 31, 1893, the announcement of a paper entitled "The Moon's Atmosphere and the Kinetic Theory of Gasses," to be read next week at the meeting of the British Association at Nottingham by the author, Mr. G. H. Bryan; and since this subject was treated by me in *Nature*, Nov. 7, 1878 (15 years ago), I wrote to the author, Mr. G. H. Bryan, in reference to this. He has informed me to-day by post that this subject was dealt with in your journal, *Science*, of Feb. 24 last by Sir Robert Ball, who sent his communication to you as original, although Mr. Bryan considers it "identical in substance" with my letter in *Nature* (above mentioned) entitled "A question Raised by the Observed Absence of an Atmosphere in the Moon" (*loc. cit. sup.*)

As Sir Robert Ball makes no mention in your journal of my letter (in *Nature*). I merely wish to claim just priority here for the theory as mine and not his; since it is discussed as his—Sir Robert Ball's—in subsequent numbers of *Science*, such as that for August 18, 1893, in a paper by Prof. Liveing, of Cambridge, England, who suggests a further application of the theory in an article entitled "The Atmosphere of Stellar Space." To make a reclaim is somewhat of a task, and it would be fitting if an author's work were voluntarily recognized without his incentive; but I cannot do otherwise under the circumstances than mention the matter to you in this letter. Mr. Bryan informs me that his paper deals with "the bearing of statistical calculations on the theory," and he makes "no claim to originality except in the numerical results arrived at."

There may doubtless have been some advantage in Sir Robert Ball treating of the theory in question in your journal; but I am surprised at his not mentioning my name in connection with the theory.

S. TOLVER PRESTON.

Hamburg, Germany, Sept. 9.

FOSSILS OF THE BRIDGEPORT QUARRIES.

ONE interested in geology, while looking over the fine exhibit of Ward's Natural Science Establishment in the Anthropological building at the World's Fair, and also the geological exhibit in the Government building will notice that the finest crinoids and other fossils of the upper Silurian, Niagara Terrane, are labeled "Bridgeport, Ill." Looking up Bridgeport on the map, myself and friend found it to be only a portion of Chicago, situated