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PRESENT METHODS OF TEACHING ENTOMOLOGY AT THE UNIVERSITY OF NEBRASKA

By LAWRENCE BRUNER, *Lincoln, Neb.*

When our Secretary sent out his preliminary notification of this meeting and asked me to take part in a discussion of "present methods of teaching Entomology," the matter at first seemed of little importance so far, at least, as the speaker was concerned. However, after giving the subject some thought I have decided that it might be well at least to take the time and trouble to attempt to explain briefly a few of the methods by which the student in Nebraska is enabled to absorb some entomological information. In order to do this with an unbiased feeling it might be well as an introduction to state that the speaker began his work as Experiment Station entomologist with the explicit understanding that no teaching was to be required of him. During the twenty-two years and over since becoming connected with his present position matters have changed somewhat. Today the greater portion of the time of the entomologist, during the school year at least, is taken up with instructional duties. A department of Systematic and Economic Entomology has developed; and, thanks to the grade of students choosing the work, fairly well equipped men have been turned out to take their place among the working entomologists of the country.

It should be strictly understood by my audience also that the speaker does not consider himself a teacher in any sense of the word, neither is he conceited enough to claim any great amount of credit, if credit be due, for the plan followed in making entomologists at the University of Nebraska. The methods, if any exist, have simply evolved. Again if my audience understood the courses offered and the different classes of students who take these courses, it would be an easier matter to describe our method of teaching the subject. Of course in Nebraska as elsewhere not all the students who are obliged to take up entomological studies do so with the intention of becoming trained specialists, neither do they register for the work with the expectation of learning all there is to be known concerning insects. In fact, though I do not like to confess it, many of the students who do register for entomology in our institution, do so under the impression that they are registering for "a snap." Others register because entomology is required in the particular group of studies which they have chosen. A very few students in the beginning have decided that they would like to take entomology for its own sake, but none choose the study of insects because by doing this they expect to make it the stepping stone to an independent fortune.

After it became evident that some teaching would be required of the station entomologist, a sort of general course was outlined and a series of talks prepared with the object in mind of giving the student some sort of an idea concerning the nature of insects and their relation to man. These talks were at first delivered at irregular intervals and readings were suggested for filling in the gaps. From time to time other information along entomological lines was sought for and attempts made to supply the desiderata. In this manner several distinct courses have been developed so that at the present time the student has an opportunity to select at least a dozen or more distinct lines of work in the department. In the School of Agriculture the entomology offered at present is simply in the form of a series of lectures of the nature already mentioned, and no laboratory work aside from reading is asked of the students. By far the larger number of our students are of this class. It might be well to add parenthetically that even the domestic science girls are obliged to listen to the haranguing of the entomologist hoping that they will learn something about protecting the weary wayfarer from the attacks of certain insect enemies of man and, incidentally, also learn how to fight flies and brush lice off their house plants. It is likewise expected that after having pursued this study they will adopt the most approved methods of catching and killing fleas.

The real entomological instruction, however, begins with a course on general entomology in which the Class Insecta as a whole is reviewed. In this course the professor attempts to outline his talks in such a manner as to describe Arthropod structure, to give information concerning the transformations, distribution and behavior of the various representatives of the Class Insecta, and to a limited extent of the more nearly related forms; to describe the chief characteristics of the orders, sub-orders and important families of insects, as well as to mention and describe briefly the life-histories and habits of typical species. These lectures are usually arranged so as to be accompanied by suitable stereoptican views. In connection with the lectures all students who register for this course are obliged to do certain laboratory work, two hours in the laboratory being required for each lecture period. In the laboratory the student is expected to make dissections of typical representatives of the various insect orders and also to try to represent the work being done by drawings. This course in general entomology is planned to meet the demands of both the general and the special student because, since certain of our courses in the College of Agriculture require entomology later on, these general students must necessarily take up different lines of entomological work the basis for which is practically the same. Our special students, however, who intend to make entomology their major subject while in college are handled quite

differently, as will be shown further on. In the laboratory work just referred to only the coarse external structure is studied so as to obtain sufficient knowledge of the anatomy of insects to aid in their classification. In connection with the laboratory and lecture work some readings are required, though not extensive, it being supposed that the lecture notes, if taken down rather fully and studied later on will be of sufficient guidance to the student to enable him to gain the information which it is the instructor's desire to impart. No regular text-book is used till the second semester when the student is advised to secure a copy of either Comstock's Manual or Kellogg's American Insects. The special student, however, is required to study all of the texts he can find the time to examine.

In the second semester of the year the laboratory work is greatly modified. The student is now supposed to learn to discriminate between orders, families, genera and species. In other words, the student is taught to classify insects. He is also supposed to do some field work, this field work to consist of collecting insects, noting something concerning their food-habits, their methods of life, their distribution, and in some instances even to observe life-histories by means of rearing and taking notes on one or more common forms. In his food-habit investigations he is directed to note the difference between carnivorous and herbivorous; he is also led to see the difference between predaceous and parasitic insects. In connection with the lectures for the semester such subjects as "parasitism," insect dispersal or distribution, effects of climate, insect diseases, reproduction, methods of insect control, artificial and natural, etc., are discussed. As my audience may imagine, it is hoped in this manner to make the general entomology a basis for the special work which is to follow later on in the student's college career.

While it would be possible for the entomology student to pursue his morphological and embryological studies in the department of entomology, it has been our custom in Nebraska to have him do this in the department of zoölogy which is better equipped for this class of work. In like manner the department of horticulture is better equipped for spraying demonstrations in connection with the handling of certain fruit and shade tree pests.

In speaking of methods pursued in teaching the special student, it might be well to add that should the student decide before beginning his work in the department of entomology and inform the instructor that he intends to specialize, he would be given additional laboratory work in connection with the study of the insect's body, some internal anatomy in addition to the external structure which is required of the general student. He would also be directed to register in the depart-

ment of zoölogy where he should take a course known as "General Zoölogy." He is likewise requested to take a similar course in botany as early in his college career as possible.

It might be of interest for me at this point to state incidentally that in training students for doing entomological work it has always been the aim at Nebraska to see that our students study such languages as Latin, German, French and, if convenient to do so, also to add at least one semester of Spanish or Italian. We have thought this action on the part of the student to be of much importance since so many of the entomological publications which he must consult during his career as an entomologist are published in these languages, and he should be able to read them in a sort of way at least. In addition to the study of languages and the botany and zoölogy already referred to, we aim to have the special student learn how to construct synoptical keys or tables of the orders, families, genera and species. For the purpose of testing these tables they are put in the hands of first-year students who should be able to determine insects by their aid, and until this is possible, the student is requested to continue to revise. He is also set to work on preparing bibliographies of various kinds. These bibliographies deal with such subjects as the insect enemies of some particular order, family or genus; or possibly, they are based on the literature referring to the various insects affecting some special host-plant, or it may be constitutes the literature referring to the insect fauna of some special region.

After having started a student on his road towards specializing in the subject of entomology, although he may be but a second or third year man, it is our custom to have him decide upon and elect some particular group for his more especial study. When he has done this, one of the first things necessary is the gathering together of both the available material and literature. After this has been accomplished he is requested to look over various published bibliographies so as to find and designate the additional literature necessary to be secured by the department in order to enable him to carry on his studies. In the meanwhile he is set to work collecting all such material in the line of specimens of the insects to be studied that it is possible for him to secure. While doing the collecting, if any interesting facts are observed in connection with the specimens being studied, it is required that notes be made describing such characteristics, etc. Later on in the course of his studies these notes are to be used as a basis for papers to be written and which can be used, if so desired, towards satisfying the English department's demand for themes. Occasionally these papers can also be utilized in the local entomological club to which all special students of entomology belong. In this manner the student is enabled

to satisfy, to some extent at least, two or more of his instructors with the same expenditure of time and waste of gray matter.

Reference has been made to the Seminar work in connection with the local entomological club. It might be well to state that all efforts put forth by the student in preparing papers for, and in taking part in, the discussions of this club are recognized by the department of entomology to the extent that regular college credit is given for these efforts. The head of the department, however, reserves the right to criticize and correct the papers thus offered to the same extent that he would papers prepared exclusively for the department.

In teaching the systematic side of entomology our method has always been to start the student out by having him learn to recognize at a glance the orders to which various insects belong. After he has succeeded in doing this fairly well so far as the larger and more easily recognized orders are concerned, he is then required to pick out representatives of some of the principal families of each of them, and later sections of families or genera, and finally species.

In our instructional activities in Nebraska we have attempted to include as much field work as possible. We accordingly have our second, third, and fourth year, as well as graduate students accompany the professor on field trips whenever practicable. This plan, by the way, was the usual custom in earlier years at Nebraska and some of the first students who were trained obtained a very large percentage of their entomological training in this manner. During later years, however, this scheme has been less convenient on account of the lack of facilities for getting out into the state and afield. During the earlier years our railroads were permitted to issue complimentary transportation and the professor of entomology was not averse to accepting as much of this kind as it was possible to persuade the companies to issue. Accordingly many of the field trips in past years lasted for periods varying from a day or two to two or three months in extent and most of the accessible portions of the state were thus reached and more or less carefully studied. This plan of having the student accompany the professor into the field was not entirely a one-sided proposition either; since by the combined energies of many special students, during the numerous field expeditions, there has been an accumulation of a much greater number of facts concerning our insect fauna than could otherwise have been accomplished.

While referring to lectures as a means of instruction it might be of interest to state that we have found considerable value in the use of "startling statements." By "startling statements" is meant references to peculiar structural features as found in certain insects, odd life habits, rapidity of multiplication, location of some of the sense

organs, etc. Such statements in our judgment tend towards working up interest among non-technical students. It is sometimes possible that by such simple methods an occasional non-entomologically inclined student will become aroused from his apathy in "bugs" and "bug lore" and gain an interest sufficient to lead him into life-history investigations on his own account, and later to the adoption of entomology as a study. Of course when once started he will go on and become a "bug crank" of whom it will be said, "When in college he studied and collected bugs" and perhaps in after life choose to occupy some of his leisure time in studying some group of insects as a pastime.

In Nebraska we have seldom obtained our special students by trusting to their coming in and choosing the study by themselves. In most instances our students have been "discovered." Such "discoveries" were made during visits to farmers' institutes, teachers' association meetings or while addressing some of the high schools and other organizations out over the state. We have even "discovered" a few special students through correspondence concerning some of the many insect enemies which are to be met with over the state. Occasionally young men have become sufficiently interested in some peculiar appearing insects that they have come across in their wanderings, or special insect attacks, to write to the entomologist concerning them. In our replies to these letters for information a little ingenuity often creates a desire for further information that leads the young man to begin investigations of his own. After we have learned of such an interest on the part of the various young people, they have often been induced to enter the University and take up studies in this department. In this way we have chosen men who were really interested in the study of nature in several of its branches before they came to us. After the choice was made, and the student had arrived, it then became our duty or at least an effort was made to provide the means whereby the student could pursue the desired studies without permitting him to feel that he was making too great a sacrifice of time and energy. Once the student has entered the department with the intention of becoming an entomologist, and has gone through with his general courses and had a little other training sufficient to be of aid to him while pursuing individual investigations, he is encouraged to take up special or research work. It has been our experience that nearly every young man has in mind some particular line of the work that he would prefer to follow in preference to others. Everything else being equal it would be best, therefore, for him if he could choose in a line with his desire. Should the student choose to specialize in forest entomology he is accordingly encouraged to learn some general prin-

ciples of forestry; if, on the other hand, he has an idea that he would prefer to study the insects that attack fruit and ornamental trees, it is the principle of the head of the department to suggest that he take some work along the line of horticulture. If the student wishes to make a special study of insects in their relations to diseases, then a medical course is prescribed, etc.

In addition to some of the other general requirements of the special student in the department of entomology in the University of Nebraska and which have already been referred to, it has always been insisted by us that he should learn report writing, proof reading, editing, etc.; in fact, he should learn to act as a sort of private secretary to the entomologist by taking dictation and writing many of the economic and other letters of the department. He is also utilized at times throughout the several years of his college course as laboratory instructor, librarian, breeding-cage overseer and to perform such other matters as incidentally come up from time to time in the department, including "janitor work, bottle washing, and cooking," as one student remarked not long ago.

Fortunately in Nebraska it has been possible for the professor who is also the state entomologist to turn some of the special funds which have been appropriated by the State Legislature from time to time, for his use in fighting insects, so as to put them into the hands of these special students by engaging them to assist in the various kinds of field investigations that come up from time to time as well as to pay them for some of the time allotted to the various activities mentioned above. In this manner it was and is possible to keep the student occupied in entomological work during the summer vacation. While perhaps not giving him as much income as he might obtain from other employment, the continual coming in contact with matters entomological in part compensates him for the shortness of the pecuniary compensation.

PRESIDENT SANDERSON: The discussion will be led by Dr. Smith.

MR. J. B. SMITH: Mr. President and Gentlemen: I think we all appreciate the difficulty of discussing this series of papers, where almost every phase of the subject has been treated very thoroughly. There seems to be one agreement on the part of all who have taken up the subject, and that is, the desirability of laboratory work, and as much of it as is possible; and the marvel to me has been, as I have listened to the papers, where in the world the time comes from for college students to do all that is expected of them. Now, I will admit that so far as my teaching is concerned, I have never been able to

secure time to do what apparently has been done by other teachers. The nearest approach to it has been brought out by Dr. Fernald but only incidentally in some suggestions. He said, if I recollect, that it was important that the student should have a good general knowledge, that he should have a good foundation for work, and that if anything had to be cut in the making of an entomologist, the entomology might, in some cases, be cut to good advantage; and now I am not sure but that is true. That a relatively small amount of entomology in the undergraduate course is in itself as good as the devotion of a great amount of time, a number of hours through the entire course, to the neglect, necessarily, of some fundamental study. There seems, also, in all the papers, to be rather an ignoring of what might be called an Eastern college course. The point of view seems to be from the standpoint of a rather mature student, a man who enters the college with the idea of pursuing a certain study, and who has a definite point in view. In our institution in New Jersey the first year is prescribed for all scientific studies; there is no election. The idea is that every man who enters college should have a fundamental training that leads to making a good citizen of him. Entomology does not enter into the course until the second semester of the junior year at all, and for those students that take only the biological course that is all the entomology they get, and that is all that they have time for. Now we work our men six days in the week—five full days, morning and afternoon, and more or less the sixth day, and they work from nine o'clock in the morning—some of them consider chapel work, too—and until four o'clock, and some until five o'clock. That is a long enough day for a college student, and if taken thoroughly, is all he can do. In that first semester, or rather the semester in the junior year, both the biological and agricultural students are placed on the same plane, and the object in that course is to teach them something about the structure and the general classification of insects; the relation of insects to other animate nature,—that is their place in nature, and as the course is developed, a considerable amount of time is given to diseases, both of plant and animal. A great many of our men who take the biological course do so as preliminary to a medical course. We do not aim, in our institution, to turn out trained entomologists. Those students who pursue the agricultural course have not the time; agriculture in its broad sense will take up the time of any man for four years if he wants to pursue it, and leave only a small margin for entomology. In the last half of the senior year the agricultural students get a training in economic entomology, but that training is not enough at any time to turn out a man who is ready to take a position for entomological work.

In planning the course I have distinctly eliminated the idea of training men to take positions in entomology. I have advised men who have taken the course with me, and who have wished to specialize in it, to go somewhere else for the postgraduate course, particularly because I think it would be better for them to get a different view point, and partly because of the multiplicity of duties that fall upon the entomologist, and really make it impossible for him to give a good postgraduate course, so that I have not had a single postgraduate student, and am not looking for any. I have not turned out more than one or two men that have followed entomology, and that have made a success of it. I do not consider myself a failure as a teacher, because I have turned out a good many other men who have done good work, and whom I meet occasionally, and who remember the instruction received from me. Now there is one point that was not brought out, except in a very incidental way, and I think possibly Professor Bruner referred to it, and that is, that in the course of laboratory work a teacher can do an enormous amount of teaching while watching the boys in their work, talking to them and telling about the relation of the insects to other subjects, and doing it without the formality that a lecture implies, and then suggesting to them that in making their notes they also incorporate as much as possible of what has been told them. Their own work is always easily separable from what they remember having been told. I have been extremely interested in the papers, and yet not a single one has touched the case as it lies in my own institution, and where, as I think it may be possible in other institutions, we are not able to take the students out for field work. Naturally the situation of an institution has a great deal to do with the manner in which the natural sciences are taught, and especially so in entomology. We have always plenty of material to work with, but it is mostly material that has been collected for the students, and they have very little opportunity of going into the field, although they get some chance in my department and in the horticultural department to do practical work in spraying. I follow Professor Bruner's suggestion in that respect and turn over to the Horticultural Department a good deal of the practical work of spraying.

SECRETARY BURGESS: I wish to say in regard to arranging for the symposium, that I asked Dr. Bethune and Dr. Wheeler to take part. Dr. Bethune wrote that he could not be here on account of the fact that it was necessary for him to submit to an operation at this time, and Dr. Wheeler, I believe, is away on his vacation. It might be interesting to note that the arrangement of Harvard postgraduate work in entomology is to have the session last through the summer,

and the vacation in the winter. Professor Kellogg wrote that he could not be present, but at that time said he could send some remarks, but I have not received them. Dr. Forbes wrote that he might be here.

PRESIDENT SANDERSON: I am very much interested in this discussion, but it struck me that the papers were all dealing in the preparation of the entomologist. Now, I think most of us have to deal with the preparation of the farmer and the fruit grower generally, and there are only a few of us who have the privilege of training up entomologists. I take it that the teaching of entomology is just as important for the masses, as it is to train up the few who are going to be the workers, and I wish we might have discussion on that phase of the subject. For instance, how are we going to teach these men, like Professor Osborn has mentioned, these two-year men, the kind of men we find in the School of Agriculture? We are getting an increasing number of this class of men. What sort of work is given in entomology? How do you get them, for instance, familiar with the plum curculio, and the various other forms of injurious insects? Do you merely tell them about them, and show them a lantern slide? Do you discuss a family of insects, and have a case of specimens, which you put on your table and invite your students to look at? Now these are some of the things that have occurred to me. How do you do field work in the winter—your school classes begin the first of October, and you get out the first of June? Should entomology be required in all agricultural courses? Many would say "yes," many "no," and yet how many say they took the course, not because they did not know much about it, but because it was a snap, for they got the same pedagogical value from it as from some other course? Then, another thing, is the systematic work; is it of any real value to a man, and is it taught in such a way that it will be of value to him? If any of you want any suggestions along this line, if you ever get a chance, talk to Professor Lochhead of Canada. His idea of entomology is of teaching it just hind side to; of starting by giving the students the economic phases, and then taking them out into the orchard and saying, "Is this insect beneficial or injurious; how are you going to tell?" It then occurs to them that systematic entomology has some application. I have tried to interest a class of students who have no idea of going into entomology. How can one give those men a training that will be of any practical value to them? I believe if we went so far as to make elective economic entomology, it might not be a mistake.

MR. J. B. SMITH: We have a short course at our institution, and it is really a short course, only lasts thirteen weeks, and I give a series

of lectures. An assistant does work with the students one hour in the morning, and four afternoon hours in the divided classes, so that every student gets a little information early in the period. Every one of the questions the president has asked has come to me, and at the same time I do not make the slightest effort to teach systematic entomology, beyond the teaching of orders; but what I do undertake is to teach how to tell the difference between an injurious insect and one that is not injurious, or between one that can do a certain kind of damage, and one that can do another kind. And then, in regard to another matter that was brought up, and that is, how do the men recognize these insects. I make it a point to have collected during each season, as many of the common injurious insects as it is possible to get hold of. Of course, we cannot get all the injurious insects, but we can secure plenty of plum curculio, plenty of bark borers, and plenty of the work of these insects, even if it is necessary to bring in the trunk of a whole tree that they may see the actual work, and they are expected to do some practical work. I think we can do a good deal of teaching, even in a short time, in this way.

MR. ROGERS: The question of using charts and lantern slides to present beautiful pictures may not be the best way of teaching. I know a teacher who, in his books, has some very fine diagrammatic illustrations, and prior to the time we would go into the room we were expected to draw these exactly. Now it struck me that was not the best way of presenting a subject. Personally I am poor at drawing, but I would rather draw one part, and extend that to another until finally I had made the whole diagram, as requiring less effort than some other form of study, but it would be good training if the student applied it in entomology. Now, there was another point brought out, and about which I talked with Mr. Headlee here, and that is, teaching a certain subject back end to. I found that I had a little more work than I could handle, and in teaching physiology it occurred to me that I was not teaching anatomy just right, that instead of going over all the bones of the body, then finally the muscles uniting them, and so the whole frame, I would take just the trunk, and then the ligaments and then the bones. The main object I had in view, was that the student had to obtain certain ideas when he was in school. I never supposed when I was gathering Vermes and Arthropoda that it would ever be up to me to teach the subject, so I thought it was better to proceed in zoölogy with a definite study of one species, and learn that thoroughly. I note that some of the discussions here suggest preceding the study of entomology by zoölogy.

MR. GOSSARD: I should like very much to hear from Professors Washburn and Summers on this subject.

MR. SUMMERS: I am not so modest as Professor Washburn, so will talk before he does. I am out of the teaching of entomology, almost, to my great regret, and I can only say a word or two about one or two special problems at this moment. One special problem that I have at present is to arrange a very brief course required in entomology for certain agricultural students who have had insufficient preparation in general zoölogy, a course that is not at all worthy of a place in any institution, that is, one fit for the college student; the short course student takes but a thirteen weeks' course. Now, what we will do in the case of the student who comes to us with no preparation in general zoölogy, and to whom we are to give instruction for a single semester in entomology, is really my great problem. I have a strong feeling in connection with our courses in entomology, that we ought either to demand sufficient time to give a respectable course to students who take up that work, or that we ought to refuse to teach it at all; and I have done so the present year. Within three hours of taking the train to come to this meeting—I refused to teach a course in my department that was to have only partial time for one semester, in which I was expected to give training to forestry students in forest entomology—no general zoölogy, no general entomology. I think the reasons for that hardly need explaining.

MR. WASHBURN: I think Professor Summers hit the nail on the head when he refused to give instruction on such meager general knowledge. Now, Mr. Chairman, I approach this subject from a different point of view from that taken by any one else, and I think Mr. Gossard may be a little disappointed in what I have to say. From the nature of my position, my ambition is to do the very best economic work possible, and to do that, we need in Minnesota, as we all need, trained men. We have great difficulty in finding men of experience to take positions of responsibility in this line. What is the reason? I can only answer for my own institution. I do not think the Board of Regents appreciates the importance of entomology, practical entomology, or any entomology. I do not know whether that is the case in other institutions, but that is our difficulty, and I should like to see more entomology put in, and I want to get a chance at the boys when they first come into the college, so that they may learn for themselves whether they like entomology or not. Now, I have drawn a resolution, Mr. Chairman, which it will do no harm, I am sure, to present at this time. It might be helpful to some of us, and certainly could not harm us, though Dr. Smith and Professor Summers might not agree with me.

PRESIDENT SANDERSON: There would be no objection to the

presentation of the resolution at this time. It might be read at this time and considered tomorrow.

MR. WASHBURN: In view of the increasing demand for trained entomologists, and the lack of properly qualified men to fill these positions, it is hereby resolved by the Entomological Society of America, and the American Association of Economic Entomologists, in joint meeting, that boards of regents in universities and agricultural colleges be urged to give all possible teaching in this practical subject, both in undergraduate and graduate work.

MR. J. B. SMITH: I have no objection to this.

PRESIDENT SANDERSON: It might not be a bad idea to refer this matter to the committee on resolutions, Messrs. Headlee, Sanders and Symons.

MR. SYMONS: Mr. Chairman, as we will not have a chance to take this matter up again, I should like to say a few words in regard to the future outlook. Certainly if the work is left undone, as suggested by Dr. Smith and Professor Summers, and you get out of it by not giving the proper courses, I think you will find that other departments in the institution will take up the time you have had for teaching. In other words, if you do not push the work, and demand a certain time for it, is there not going to come a time when there will be very little teaching of entomology in your agricultural colleges and universities. I might say I have had some very hard work in Maryland. We had a very limited course, and I maintained that the course was not sufficient, and felt justified in endeavoring to increase it; and during the last two or three years we have increased our courses from, I believe, about four to twenty, and the only regret I have is that I cannot impress upon the president the fact that he should appropriate more money for doing this work.

MR. J. B. SMITH: You have increased from four to twenty what?

MR. SYMONS: Courses in entomology. We have two-week, ten-week, two-year in horticulture and agriculture, and regular four-year students, and in this regard I would say we have time to get the boys when they first come to college, and introduce the work into the preparatory courses. I have recently revised the curriculum and raised the standard, and in doing that was able to get in more time for entomology and zoölogy. 'When I said twenty courses, I referred to both entomology and zoölogy. We have had excellent results with the "preps" and freshmen in taking practical work, and it certainly seems very desirable to give them practical work in elementary courses that will establish their interest in zoölogical work; but as I say, I am confronted with the question of securing sufficient money to carry on these courses properly without making it embarrassing to

my state fund. Another question arises in regard to the amount of instruction given in the public schools of our states. How many public schools of this country are teaching entomology? I firmly believe all of them should be teaching it in an elementary way. It could be taught much easier than many other subjects, it seems to me.

MR. S. J. HUNTER: I have been very much interested in the discussion this afternoon, because it has presented a phase of the subject that I am not familiar with from experience, because in Kansas we have no short courses. I take it for granted that it was intended that each should say something about his own institution in regard to the work done. I think every one of us has been impressed with the students' change of attitude toward the institution from the day he begins, when the thing is "a bug," and the day he leaves with a proper view of life. At the University of Kansas we require zoölogy for entrance. Entomology we do not absolutely require, but we see that the student takes it before passing out of the course. We endeavor to make entomology a two-year course, taking the man in the sophomore year; the first year, three days a week is given to two hours' laboratory work, two days a week to systematic study through the year, at the close of which we expect the student to be familiar with all the common forms as far as the family. The next year he gets more of the same, but we have no special work students until the graduate year. We insist upon the first year's work being as intensive as possible. Of course, we recognize the fact that many of our students do not go on with entomology.

MR. SWENK: Regarding the instruction in entomology, and the advisability of such a course in a secondary school: in Nebraska we have three courses, the summer school,—the School of Agriculture offers four years,—and a six weeks' course in the winter, known as the winter course. Now, as an answer to the question as to whether entomology has a place as a required subject, I would say that the competition for a place as a required course in the four-year course is quite keen at our institution, and the law of the "survival of the fittest" has not ceased to operate. In this course if we were not giving practical instruction it would, in all likelihood, be dropped, because the subject is not a prime favorite. Now, the method of teaching, as employed at this institution, is, as Professor Bruner says, one that simply evolved during the past eight or nine years. It has been changed in different points from year to year, especially during the latter years, and as we are presenting it at the present time it seems to give some measure of success. Still, we find the work must be made exceedingly elementary. These boys come to the school, many of them, very green, and with very insufficient preparation,

and what they want is the most practical instruction. About 90% of the boys return to the farm at once, and of the 10% which continue, the most of these go on in the College of Agriculture and specialize in various lines, fitting themselves for experiment stations and other positions, and so the problem concerning us is to implant in the men something that will be of value to them. We start in the four-year course with the men, which is the most important of the three, by trying to give every student a good foundation. We give them some idea of the transformations of insects, and something of biology, and something of classification, but we do not give this instruction in the terms I would use to you. We make it perfectly simple, and illustrate it as far as possible. We make much use of demonstration materials in the class room, and that, up to this time, has taken the place of laboratory work. We then take up the study of orders. We do not use technical names any more than necessary. Our object is to give a general idea of the different types of insects, and something of the relationship of the different forms, something of the life history. This takes up the winter semester, and is considered the ground work. At the end of this the work changes radically, we turn about and face the practical side of the problem as intensively as possible. We take up in succession the particular crop pests of our own section, beginning with the chinch bug, the Hessian fly, wire worms, corn worms, etc., taking these in turn and giving an idea of the appearance of the insect, so that the student can see the importance of the study. In these demonstrations some Riker mounts are employed, and others we have prepared, exhibiting the life history, cases showing the work and the insect in its varied stages. These are placed on exhibition, and sometimes we dismiss the class, so that each student can view the insects and their work. The student then gets a good idea of the pest. We then deal with the life history, but only so far as the life history involves methods of control. We try to show the student why we apply certain methods of control, and try to give the most practical information we can impart. The work with the women, perhaps, is not so pertinent here, but the first semester is practically the same; the second is devoted to household insects and human health. In the case of the short course, the subject is presented in an even less technical way—demonstration material and lantern slides—we do not deprecate the use of lantern slides. This is another way of placing before the students a concrete idea of the work in hand. As to the practical results of these methods I will say that many students, when they return to the farm, write in concerning certain pests, and the intelligence displayed in the questions asked indicates that the man has been a student in our institution, without

our having to refer back to our records. We are now about to undertake a rather important step. The work has been given in the freshman year, and we have found that while we have had some success, yet we feel we can do much better if we advance the work two years, giving it in the third year. So the work from now on will be given in the third year, and we are attempting to give some laboratory work with it, and that is exceedingly difficult to work out.

MR. SANDERS: I believe one of our greatest difficulties in teaching entomology is that we work from cause to effect, rather than from effect to cause. I have found in my work in Wisconsin that I can get the interest of fruit growers very much better by addressing them on the work of apple insects, and from that to the life history stage by stage, working from the injury to the insect. I have applied that method in my teaching to a large extent, and have taken the work from effect to cause. Another thing I thoroughly believe in is to divide and subdivide classes into small groups of six or eight, and to talk to them in a conversational tone, using lantern slides, if necessary. I believe personal contact with your men is far better than attempting to teach a large number in a lecture.

PROFESSOR SUMMERS: I move we adjourn. Seconded. Carried.

Morning session, Thursday, December 29, 1910

Meeting called to order at 10.30 A. M., in Entomology Lecture Room, Main Building, Department of Agriculture, St. Anthony Park, Minn., by President Sanderson.

PRESIDENT SANDERSON: The first thing on the program for this morning is the discussion of the presidential address. I will call Professor Summers to the chair again.

MR. SUMMERS (in the chair): Gentlemen, our presidential address is open for discussion. As I remember it,—it is such a long time since it was delivered,—he said something about preceding presidential addresses being deeper and of greater import. I think all of us here, without exception, will make an amendment to that, and strike out the reference to past addresses. The discussion is open.

MR. OSBORN: It is pretty hard to say which of the many strong points in the president's address impressed me most. There were a number of points which impressed me at the time, but several things have come up since to drive them out of my mind; but one, the matter of coöperation, it seems to me, is a very sensible idea. Now, as stated in that address, a number of years ago a committee attempted

to do something in that line. We then experienced difficulty in securing coöperation, and while the situation is perhaps somewhat better now, still there is a good deal of it with the work in each station, and the work in each state will be determined by that of the station. Some work does not permit of coöperation, though I think the general idea is practicable.

PROFESSOR WASHBURN: I think perhaps the thought may have occurred to some of us that the method suggested by Professor Sanderson might possibly make one less original. In other words, there would be a tendency to fall into the ways of others, and we would be very apt to adopt their ways and methods instead of originating something ourselves. It is undoubtedly a mighty good thing to know what other men are working on, but just how far we should go as to the interchange of methods I do not know. It seems to me each man must determine that for himself. It would appear that the Office of Experiment Stations has some pretty good reason for not giving out what their Adams Fund men are working on. I should be very glad to find some man who is working along the same line I am, though I should not like to see a system established by which we were obliged, or even advised to give out every bit of work before publication. That is purely a personal view.

MR. J. B. SMITH: This matter has been brought to my attention several times,—the idea of somebody else working along the same lines that I, myself, was working. I have no fear that it would hinder originality in any sense, but my experience has been that I should like to have my own results and conclusions checked up by somebody who was working along the same line under somewhat different conditions. I have frequently got bulletins in which an allusion was made to certain work, and upon reading them over I decided, "Well, now, that may be all right where that work was done, but it does not apply here." The insects that are counted of so much importance in that bulletin as to require treatment, are practically of no importance in our state, and it would be a waste of time and money if we were to treat them in the same way. I have sometimes felt that possibly I was doing work which I considered important and far reaching that, after all, might be only of local interest, and if I had some way of knowing what others were doing along that line, it would be of considerable help. Of course, the man who originates a new line of investigation who takes up a path that is a little different from that of others, likes to be credited with taking up that line of investigation, and I do not see why that is not possible. Suppose we find two or three men who are working on the plum curculio, to take a common insect. Now I might think a certain point had not

been sufficiently studied, or there was a new way of studying the problem, or the method of dealing with it. I might suggest that, with the understanding that whatever experiments were made along that line should be credited to me as making the suggestion. Let the man who does the work get all the credit for the work, but let him give due credit to the man who made the suggestion, and then if you publish in two or three states at approximately the same time it will be possible to tell just what importance is to be attributed to the suggestion, and the results will, of course, be of infinitely more value than if the line of work were carried on by one individual only. I think we ought not to go away without taking some steps toward putting the president's recommendation into a tangible shape.

MR. LOWE: President Sanderson's address has been most inspiring to me, as I shall go back to my work with the possibility of not meeting another entomologist for a year, as I have done the past year. Touching the point which Professor Osborn raised, of coöperation, I think it is very desirable, but one that we would find difficult in our work. We are developing methods along a new line of work that we could not give out to many men to work on. We want accuracy of results, and in that respect I might refer to Mr. Washburn's remarks about the interchange between entomologists at work upon one line of investigation, and Dr. Headlee's paper on projects; all of which I feel are going to help me a good deal in my work. I thank President Sanderson particularly for his address.

MR. GOSSARD: In talking with members upon this subject I am impressed with the idea that the great difficulty we have is in finding some workable plan by which we can know what others are doing. I do not believe it would interfere at all with the work, and so far as duplication is concerned, we might profit by it. Personally, it has seemed to me that duplication in publication upon some of the great problems of entomology was exceedingly desirable. We called attention to the point, when Dr. Headlee wrote us that we really had no satisfactory method for controlling the codling moth until it has been worked over by a number of men. We have to work those things out, each one in his own state. There are from one to a dozen other great entomological problems in which we would make great progress, and in which we would do more for the public good if we had some sort of team work. It has seemed to us that our great difficulty in advancing scientific entomology is this. We have a somewhat similar condition in what used to be known as "Agriculture." It was pretty generally agreed that it was a study which was sort of divided off into different departments, each having its work. It became scientific agriculture as the different departments worked

together, and it appears to me that except for the systematic part of it, economic entomology is very much in that condition. We recognize this in a way, and yet there is no classification, and a young worker cannot tell just who among the entomologists are interested in those things in which he is especially interested. Now, if we knew those entomologists who had taken chemistry, those who had taken pathology, and those who had taken horticulture or mechanics, and we had a method of classification,—it would have to be rough in the first place,—but it would enable any student to consult with the few who were interested in those themes in which he was interested, and would create a sort of division of economic entomology, in which there would be chemical economic entomology, the mechanical economic entomology, the horticultural, the pathological, etc., and it seems to me we could coöperate in that way better than we could by having a committee, and know, at least, just exactly what we were doing. I should feel considerable trepidation if I should undertake to tell some of the veterans what they ought to be doing, and I am quite certain that no committee would feel like fixing the lines as to what any man should be or should not be doing. It would be useful to have some such statement as Professor Headlee proposes each year, to see who is working on each problem.

MR. WASHBURN: We have no time for a debate, but at the same time I do not want to be misunderstood. I believe thoroughly in coöperation. I believe in knowing what each one is doing, it would forward the cause, but at the same time human nature is very much the same, and I think if some one, who perhaps is a little more original than others, should pursue certain methods in investigating the codling moth, for instance, we might, at least some of us, follow the same methods, because it is so easy to follow, and yet those methods might not be so good for our state as something we had thought of ourselves. At the same time, that does not oppose coöperation.

MR. R. L. WEBSTER: It seems to me the general idea of coöperation is a very good one to most of us. As it is, we have, in a way, divided the work, giving one man a problem in one state, and another man another. We really do not know much about an insect until we have seen it two or three years, and studied its life history, and our work must be largely independent. I believe as Professor Gossard says, we could get a great deal out of coöperation, but we must get in and dig. Regarding originality, I think it always shows itself in publications; there is always the stamp of it in entomological bulletins or articles. By looking them over you can see whether the author has really got in and worked out the facts, or if he has simply bor-

rowed from other publications. I would like to do some work in coöperation with other men.

MR. SYMONS: I wish to express my appreciation of the president's address, and I wonder if it would be out of the way to suggest the appointment of a standing committee to carry out this idea, mentioned by Dr. Headlee, to start a system of uniform methods, which we could all agree to, as treatment against various pests. We have a standing committee which has done most excellent work in the suggestion of common names, and I wonder if we could not make a start on a uniform method in the treatment of some of our insect pests. For instance, it would not be out of the way for this Association to indorse the lime-sulphur treatment for San José scale. Anything that will tend to strengthen our position, it seems to me; will be advantageous. As was pointed out by President Sanderson in regard to the chemists, their methods are accepted by practically all official chemists, and it may be that we could make a start.

MR. HUNTER: I think that the president's address was one that looked far into the future. It deals with the problem that is before us, not only in our own line, but practically all lines. The question is whether the greatest advance in science is to be through coöperation or competition. It seems to me the important thing is the advancement of science rather than of any personal matter. Now, I think that one speaker spoke very well when he said there was a great difficulty in formulating plans. I think we all agree that plans, however thoroughly recognized, are of little avail unless the true spirit is evident. We have taken up the matter of coöperation in our own institution, in the past few years in larger degree than ever before, and, speaking personally, I must say that it has not seemed a curb to individuality or originality, but rather to stimulate it. For instance, in one problem our department had under way, about completed now, the problem was turned over to our department and the department of bacteriology; another one was turned over to our department and that of biology, dealing with the external and internal features, and there are a number of problems in our state being worked out by our institution, and all through the departments working together. It has been to me a personal stimulus to better and more thorough work, and I am going away from this meeting with a deepened impression of the unanimity of spirit manifest here.

MR. HEADLEE: It has surely seemed to me that one of the greatest results that can come from the work of such a committee is the inspiration that such a committee may give as the result of broad-gauged discussion of the projects. It should get out a report which should stand, in respect to this work, much as the Carnegie reports stand in

respect to education—something that looks toward the future, something that holds up an ideal, something that influences men by directing them. This committee cannot command, and say you shall do this and the other thing. It can merely stand as an inspiration to us, and that is the kind of work I should like to see this committee do. It is the kind that would help me, and not for one moment do I believe that acquaintance with plans under consideration will reduce originality. It will form a basis of effort. One man will find out what another man is interested in, and he will look at that plan, and if it appears good to him he will adopt it. We are after the advancement of our science, rather than the advancement of the individual. There may be a minority of men in the country at large, I believe, who are firmly of the opinion that if their plans become known, they are so good and so desirable, that those of us that can will take up their ideas and work them out before they have finished. Now, the reason one party gave me for the office of experiment stations not divulging the plans of other entomologists was along this line. The office had refused to tell him the plans because certain entomologists were afraid their plans would be taken up and worked out by somebody else before their work was finished.

PRESIDENT SANDERSON: If it is in order, I should like to make a remark. I appreciate very much the cordial expressions in regard to coöperation, and I might say in explanation that the idea of coöperation I intended to convey was that it was to be purely voluntary. My main idea was that we could further this work through greater publicity, and Dr. Headlee has expressed the idea very clearly. There is one other point—with all due deference to originality, and I think I do not want to do anything which would retard originality, I feel that we have sometimes suffered from over-originality. If all the chemists were working by individual methods, we would have a very sad state of affairs. Now take in entomology, as a matter of comparison, the results of the codling moth work, which we have alluded to previously. I would not say we must all work alike, but at least try to get together. And then, this matter of team work, which Professor Headlee has spoken of, I think any of you who have had anything to do with station work, will appreciate that fact. Team work is the coming thing. Some of the biggest men in the Department of Agriculture have done their best in team work, and yet we have men in every station who do not want to pull with the other fellow because they are afraid he will get ahead of them. We do not want to frustrate originality, but men must be brought to realize the importance of working together. If we have to put a horticulturist, a botanist, a chemist and an entomologist on a problem all together for the proper

working out of the problem, it must be done. What Dr. Headlee said in regard to some men holding up ideals along that line, and especially policies looking toward the future, was exactly what I had in mind.

(To be continued)