

For Member of Advisory Board of Journal, one year, Wilmon Newell, Baton Rouge, La.

For Members of Advisory Board, three years, H. T. Fernald, Amherst, Mass.; Herbert Osborn, Columbus, Ohio.

For Members of Council, S. A. Forbes, Urbana, Ill.; H. E. Summers, Ames, Iowa.

Respectfully submitted,

E. D. SANDERSON,

FRANKLIN SHERMAN, JR.,

E. S. G. TITUS,

Committee.

By vote of the Association, the Secretary was instructed to cast a ballot for the officers recommended by the Committee, and they were declared duly elected.

Mr. Sanderson called attention of the Association to the large amount of work which now devolves upon the Secretary, and stated that he thought that the expenses incurred by the Secretary in attending the annual meeting should be paid.

Mr. Britton stated that while he was heartily in favor of paying the Secretary, he believed it would be much better to pay a stated salary than to pay his expenses when attending the annual meeting.

By vote of the Association the matter of compensation of the Secretary was referred to the Executive Committee for report at the next annual meeting.

It was voted that the time and place of the next meeting be decided by the Executive Committee.

There being no further business the meeting adjourned.

PART II

The address of the President was presented at the opening session on Monday morning, as follows:

ASPECTS OF PROGRESS IN ECONOMIC ENTOMOLOGY

By S. A. FORBES, *Urbana, Ill.*

It is fifteen years since I had the honor and the privilege of presiding over the Fifth Annual Meeting of this Association at Madison, Wisconsin, and of presenting to it the annual address, and my thoughts naturally revert to the conditions of that time as a means of measuring the progress we have made. We have met some very heavy losses since 1893, in Riley, the prince of economic entomologists, and one of the great founders of our science; in Lintner, a careful, thor-

ough student, a clear, methodical writer, a correct and genial gentleman; and now in Fletcher, whose late departure has made of this society a family of mourners, each of us grieving as over a personal loss. Many others have left our little group in these fifteen years, either by the road which we all at last must travel, or drawn away from the difficult and perplexing path of economic entomology into others more inviting to them.

But serious as our loss has been, our gains, I need hardly say, have far surpassed them. I referred, I remember, in the address I have mentioned, to the time then passing as the classic period in economic entomology—the time of the beginnings of great things, when the larger features of our field were just becoming fairly outlined, when the essential methods of our work were being definitely agreed upon and brought into general use. The older method of observation, description and deductive inference—the method of Harris and Fitch and Walsh and Le Baron, and of Riley in his younger days—was yielding to the method of comprehensive survey, exact experiment, and practical verification in the field, which characterizes all our best recent work; and among the older men—self-taught entomologists most of us—were appearing a younger generation of well-trained scientists, taught, in many cases, it is true, by teachers who had themselves had no specialized training, but who taught well and thoroughly nevertheless because they were born to teach, and who had been, consequently, their own first and best-taught pupils. And now this younger generation of well-trained students, whose presence at Madison was welcomed with hopeful anticipation, is itself beginning to get a little gray at the temples and a little bald under the crown of the hat, and the country is alive with bachelors and masters of science and doctors of philosophy, a small army of whom are at work each in his special part of our general field.

Besides this great and surprising increase in the number of workers on our subject, and this very great improvement in their scientific preparation for their work, none of us who are fifteen entomological years of age can have failed to note an equally great and encouraging improvement in our methods of investigation, in our means and forms of publication, and in ways of bringing our results promptly to practical application by those in whose interest all our studies are made. Our work has become at the same time more scientific and more practical, better based in scientific principles of permanent character and wide application, and better worked out in ways to commend its results immediately to our economic constituency.

Trusting, however, to your recollection of your own observations

and experience for a sufficient review of these matters of recent history, I would like to use my present brief and rare opportunity and privilege in an endeavor to forecast the immediate future, and, judging from what we have seen and what we now see in progress, to deduce the probable next steps in the development of method in our work.

Economic entomology is an extremely complex subject, not only by reason of the number of factors which it must include, but especially because of the variability of many of these factors, and our inability to predict the course of events with certainty in our field. We study the present and the past in a practical way in order that we may predict the future. We observe, generalize, experiment and verify in order that we may be able to say to the farmer or the fruit grower, "Do thus and so in any given case, and this or that desired result will follow;" but we can rarely express our conclusions safely in so definite a form. Often the best we can fairly say is that if the weather should be wet, or dry, or neither one nor the other, as the case may be; or if it has been very wet, or very dry, for the last two or three or four years; or if the winter has been, or is to be, open or severe; if the crop in question has been preceded by some other kind of crop, or by one of the same kind; and if the insect situation was thus and so last year and the year before; if, furthermore, the land is light or heavy, high or low, well drained or wet; if it has had this or the other management or treatment during the last year or two; and if several other variable elements of the problem vary to such or such a degree, in this or the other direction—then if the operation X be performed, the result will *probably* be Y, but with what *degree* of probability it is impossible for us to say. Agriculture is itself one of the more uncertain callings, and the farmer every year bets the cost of his crop on the chances of his harvest; but the entomology of agriculture is more uncertain still, for insects liable to infest a crop are affected, directly or indirectly, obversely or inversely, by everything which affects the crop itself, and by several other things beside. How may we approximate certainty of prediction in this variable tangle of uncertainties within uncertainties in the midst of which we have to work? It is only by long-continued observation, by comprehensive survey of all related matters, by repeated and varied experiment, and by the use of *statistical methods* such as will teach us the range of variation and the character of the average in any given case. By an intelligent use of counts and estimates and averages we can often approximate certainty, where without them our uncertainty would be complete. We can say that in about such a per cent of so many trials you will get your desired

result, where otherwise we ought really to say nothing at all; and the statistical method of record and report has always the great advantage that it conveys perfectly definite information, and that it gives us a structure of fact to which the next man may safely build. It enables us to accumulate results by adding one like unit of construction to another, whereas otherwise each little structure must stand by itself for what it appears to be worth. I confidently expect to see this aid to accurate work more and more used in coming years, until a paper whose data of observation and experiment are not summed up in statistical tables or their equivalent will be as rare as the old-style paper of deductive inference to economic measures is today.

Next to the command and use of this method of statistics—a completed method ready-made to our hands, and which we have only to appropriate and adapt to our ends—I have come to look, of recent years, with eager interest to the new and still developing *methods of ecology* as an aid to our work on our larger and more difficult problems. Economic entomology is, in fact, a special division of ecology. It has to do with the relations of insects to the welfare of man. It is the science of the interactions, direct and indirect, between man on the one hand and insects on the other, in so far as these interactions affect human welfare. The welfare of man is the primary study, and entomology comes into the field only in a secondary way. Now the ecologist studies, analyzes, classifies, generalizes and interprets the relations of interaction between all organisms and their entire environment, inorganic and organic. On the side of the environment he studies all features and factors which in any way condition or affect the life of animals and plants; on the side of the organism he studies all the reactions, adaptations and immediate or final effects which are in any way traceable to the factors of the environment; and on both sides of the relation he seeks for causes, for principles, for laws, which are permanent and invariable because they are involved in the nature of things—in the nature of protoplasm on the one hand, and in that of the physical world on the other.

So regarded and so studied, ecology evidently lies at the very center of biology. Indeed, it is practically identical with biology as defined, perhaps most clearly, by that great zoölogist—that great naturalist—Brooks, of Johns Hopkins, who says in the introduction to his remarkable volume on “The Foundations of Zoölogy,” that life is response to the order of nature, that biology is the study of this response—of this reaction; and that the study of the order of nature to which response is made is as well within the province of biology as a study of the living organism which responds. Upon this topic of en-

tomological response—of ecological interaction—we economic entomologists have been busy all our working lives, whether we have made precise note of the fact or not. We are indeed, whether we have meant to be or not, the leading ecologists in America today. As practical entomologists, however, our work has run, as a rule, along too narrow lines to give us an adequate view and command of the whole field; and there is now coming to our aid a group of active young ecologists who, unfettered by any responsibility for an economic result, are working out the relations of organisms to peculiarities of local situation and condition, who are searching for the causes of local distribution and abundance in the facts of interaction and adaptation, and who are tracing also the history and development of this distribution and association of species by processes as careful and as promising of fruitful result as those which have given us the geological history of the globe. All of their most general, most important results must apply in our special field; and a knowledge and appreciation of their method will lead us to study our larger problems in the large way; to treat an entomological inquiry as merely a special item in a broad investigation, which shall include, from the beginning, all the factors which can enter into it or influence it to any significant degree. It is particularly important to us that we should have clear ideas of the system of relations existing in our several districts between insects and the *organic* world at large, before civilized man appeared upon the scene, with his associate group of intrusive animals and plants; for we can only modify or disturb, often to our own disadvantage, this primitive natural order, and can never wholly replace it. The same forces which established it in the beginning are constantly at work, not perhaps to reestablish the old order, but at least to rectify disturbances due to us and to establish finally a new order of equilibrium between the remaining remnants of the old and the intrusive elements we have introduced.

Permit me to give you a simple illustration of the application of the ecological method to the organization and discussion of the data of an economic problem; and for this purpose I will take the corn-insect problem as the one with which I am, perhaps, most familiar. From the ecological point of view a corn field is a situation—a habitat, a biotope—and its inhabitants are a biological association, or a biocenose. The assemblage of plants and animals characteristic of it is found together in the corn field because of its special fitness for their occurrence and their maintenance there, and this assemblage has had its history of first appearance and gradual transformation. It has its important relations to surrounding situations, and to their charac-

teristic associations of plants and animals—those of the pasture, the oats field, and the like—and its relations also to associations preceding it on its own area. As a biological association the inhabitants of the corn field are variously related to each other—as competitors, as enemies, as parasites, as coöperating partners, or as mere indifferent companions, and their varying actions and interactions make up the general ecological system of this corn field situation. The leading members of this association, the kinds of organisms which may almost invariably be found together in it, are certain grasses—species of *Setaria* and *Panicum* especially; and certain smartweeds or heartweeds—species of *Polygonum*—all of which start spontaneously from the seed in very early spring; the corn plant itself—whose dominance gives its name to the association, the corn-field ant (*Lasius niger americanus*), the corn root-aphis, the corn root-worm, the white-grubs, and the ear-worm; and to these we must add two other members of the group, without which there could have been no cornfield in the beginning, and none could continue so much as a single year—that is, the horse and the man. The man, the horse, the corn plant, the smartweed, the two grasses mentioned, the ants, the aphids, the grubs, and the ear-worm are the essential members of this association; but with these, I need not say, we must often include many other occasional or less conspicuous members—the wireworms and the bill-bugs, if a pasture or meadow has preceded corn within a year or two; the cutworms and the army-worm, perhaps, in spring, and the grasshoppers in fall, if such an association is established beside it; many species of birds, most of which are, as a rule, scarcely more than accidental visitants; the moles, the ground-squirrels, and the mice, which have their more or less definite reasons for frequenting it or for residing in it.

If we analyze the relations of these various inhabitants of the field we find that three of these kinds form a coöperating partnership and that two of them form another—the man, the horse and the corn plant in one such group and the corn root-aphis and the cornfield ant in the other. The interests of the former group are in open opposition to those of all the other inhabitants of the field, so much so that this group would profit greatly by the extermination of all the rest; and its dominant agent, man, being more or less aware of this fact, he seeks, as a rule, to destroy them all as completely as he can. He fails to do so completely, notwithstanding his best endeavors, because some of his competing associates are really better adapted to the situation than the corn, the horse, and the man themselves; and, furthermore, because several of the competitors of this dominant group thrive most by the very measures which it takes in its own immediate interest. The ear-

worm would be compelled to seek its food in other and much less abundant plants, the corn root-aphis would be limited to the comparatively sapless roots of the small field weeds; the cornfield ant would have to forage mainly for its food, and the corn root-worm would seemingly perish from off our area if it were not for the contributions to their welfare made by man in the pursuit of his own ends.

Similar incidental contributions of one group to the welfare of another are seen in the relations of the weeds of the field in early spring to the first seasonal appearance of the corn root-aphis, which is dependent for its maintenance on these young weeds for as much as a month before the corn has begun to grow. This seasonal succession of plants in the cornfield is thus a necessary condition to the existence of the aphis there. On the other hand the corn root-worm could not exist except for the continuance of corn in the same situation as a member of the associate group year after year; and the corn itself would fall a speedy victim to its enemies and competitors if it were not regularly relieved from the consequences of its own incapacities and its failures of adaptation by the interested aid of man. We have so cherished and protected this plant for untold generations that it is permanently fixed in a state of infantile helplessness, incapable of independent competition with the other plants of its association, and about as defenseless against insect attack as is a flock of sheep against a pack of wolves. By the constant interference of our planting and our cultivating processes, and by our selection of characters which adapt the plant to our needs, to the neglect of those which might make it independent of our care, we have wholly prevented all spontaneous adaptation of the corn plant to the conditions of its own maintenance, and it has hence made no progress towards independent life during all the centuries or millenniums of its residence in our territory.

I have wondered if, in this respect, we might not improve our selection by sometimes giving the preference, in saving seed, to those plants which have best withstood unfavorable conditions, instead of making our choice, as we now invariably do where we choose at all, from among the plants which have succeeded best where all the conditions have been favorable. I would like to see the experiment made of growing corn from seed taken from the few best stalks of a field which has been overrun by insects, in the hope that we might thus gradually develop varieties of this plant capable of withstanding insect attack, or of selecting our seed from the best grown and most fruitful plants in a field which has suffered heavily from drouth—of applying, in short, the method by which rust-resistant varieties of wheat and the like are now being formed.

This imperfect sketch and discussion of the cornfield situation may serve to illustrate the value of the ecological view in compelling a comprehensive survey of the general field in which an entomological problem is involved, and a careful mustering and orderly assembling of its whole content, insuring us against the overlooking of any significant factor or the overweighting of any minor element. Whether we use the terms of ecological discussion or not, we treat our subject imperfectly if we do not use its methods and draw our data from its whole domain.

To these general suggestions, looking towards the development of our methods of investigation, I will only add a point or two pertaining to the other side of our relationship. If entomology were the sole subject of our study, we might be satisfied with our progress if we were merely contributing to the sum of available knowledge on that subject; but if it is our special task to aid in the general work of improving the conditions of life for our people, then we can only rest satisfied when we see that the conditions of their life have actually been improved. I sometimes think that only the simpler and easier part of our work has been done when we have *discovered* the truth, and that the task of making it to prevail in the practice of life is much the more arduous and difficult. Until we, or some one else for us, can hitch fact to practice, we are as helpless to move towards our main end as is a teamster with a loaded wagon who has no harness for his team.

A general practical use of our material results is, moreover, the indispensable verification of them, preceding which they are economic hypotheses only; and we can no more stop short of this final test than the physicist can omit the verification process in his experimental studies. Anything which will help us to bring to bear on our conclusions this test of average use under the ordinary conditions of economic operation must be most welcome to us, and I hope that we may get the light of each other's experience and the help of each other's suggestions on this most difficult part of our duty. I have lately found great advantage in the establishment, in relation to the work of my office, of an advisory committee, consisting, in this case, of the director of the agricultural experiment station of the state, and of two representatives of the State Horticultural Society appointed by its president, and two representatives of the State Farmers' Institute. This committee, meeting at the call of the entomologist and in consultation with him, takes his plans under consideration and approves, amends or rejects them, according to their judgment, after full statement and discussion. The law by which it is constituted, passed at

my request, provides that the appropriations of the office shall be expended on lines approved by this committee.

I have thus in frequent consultation with me a group of thoroughly representative, public-spirited men, personally or professionally interested in the various lines of our horticultural and agricultural work, who know of and believe in our undertakings and are in a position to test our results themselves in a practical way, and to influence others to test them. They stand also as advocates of the work with the general public, whose confidence in it is naturally increased by the fact that it has in advance the approval of their representatives. I am often indebted to this advisory committee for valuable suggestions, as well as for hearty support.

I am also about to propose to the State Farmers' Institute—a very active and influential body with us—a plan for individual co-operation with the office, not in the making of experiments, but in the practical use of such methods of economic operation as I have worked out to the limit of my opportunity. I hope in this way to establish volunteer demonstration stations in different parts of the state, from which, as centers, an improved practice may spread to the surrounding communities.

Another subject which has become very practical with us in recent years is that of the legal prevention of the introduction and spread of injurious insects in our territory. We are, I suppose, practically unanimous with respect to the utility, if not the necessity, of the supervision and inspection of nurseries, so conducted as to minimize the danger of dissemination of insect and fungous pests by way of the trade in nursery stock; but we seem not to be equally unanimous with respect to the supervision, under legal authority, of the private property of the fruit grower and the farmer, with a view to the early detection and prompt removal of conditions threatening injury to the property of others. The principle involved seems to me, however, to be virtually the same in the two cases, what difference there is being in favor of the nurseryman. "Let the buyer beware," is a maxim of the common law, and under this one might reasonably expect the purchaser of nursery stock to stand the consequences of his own ignorance and inattention. He does not need to buy a particular lot of stock unless he chooses, and having chosen, it is his to do with as he likes. He may fumigate or spray or destroy it if he finds that he has unwittingly bought an insect infestation with his trees; but the owner of a valuable and well cared for orchard, free from infestation of any kind but lying beside another so infested and neglected as to make it sure that his

own will be invaded by orchard pests to his serious injury, is powerless to protect himself unless he may invoke the aid of the law. He is exposed to needless loss for which he is in no way responsible, and for which his neighbor ought in justice to be held to account. Dangerously infested property is a nuisance, and in my judgment should be universally so treated. It is true, as often said, that education and enlightened principle are in the long run a better reliance than legal compulsion, but the two are not at all incompatible, and we may have both at once. We do not find that laws making forgery or theft a crime weaken the moral sentiment of the community, but quite the contrary; neither will the passage and enforcement of laws making the maintenance of entomological nuisances a misdemeanor operate to diminish the interest of those concerned in means of detecting and measures for destroying such nuisances; they will greatly increase it rather. In my judgment, our San José scale laws are as sound in principle as our statutes concerning the contagious diseases of stock, and I am of the opinion that every entomologist should seek to have these laws strengthened and extended to all like cases, not only as measures of police but as aids to economic education.

I cannot bring to a close this address—already too long, I fear—without congratulating you upon the fact that the economic entomologist has become of recent years in a great measure a guardian of the public's health as well as a protector of its property, and expressing an earnest hope that all of us favorably situated for the purpose may lay a vigorous hold upon the problem of the relations of insects to disease, and particularly, just now, upon that of the house-fly pest—a problem of the first importance which is far from being solved. Medical opinion seems to be coming rapidly to the conclusion that the house-fly is far more dangerous to us than the mosquito, and it is certainly at present much more difficult to control. Some careful studies to this end, continued through the summer and fall under unusually favorable conditions, by a group of assistants in my office, gave us only negative results, reducing us at last to the regular removal of all materials in which house-flies can breed as the only effective means of abating this nuisance; and we found flies breeding in dangerous numbers in a greater variety of situations than we had before supposed. It will be a reproach to economic entomology if we do not soon work this problem out to a finish, and no service which we can render to our kind will be more promptly appreciated or more highly valued.

But the whole country teems with important unsolved problems

in our field, some of them, indeed, as old as agriculture in America; and new ones seem to rise faster than the old are solved. By reason of our past achievements, the country is coming to expect more and more of us, and is yearly more willing to enlarge our opportunities and support our undertakings. Whoever is privileged to look back, from this place, on the work which this Association is to do during the coming fifteen years, will certainly have a most interesting and inspiring retrospect; and, speaking in the spirit of this season of good-will to all, I wish to each and all of you joy in your work, and a large and important share in the investigations and achievements of this coming time.

Afternoon Session, Monday, December 28, 1908

The meeting was called to order by President Forbes at 1.20 p. m.
The following paper was presented:

PEMPHIGUS TESSELLATA FITCH

By EDITH M. PATCH, *Orono, Me.*

The life cycle for comparatively few of the genus *Pemphigus* is known. Because the egg stage has not been found for many of this genus a tradition has sprung up that the true sexes and egg stage are commonly lacking for *Pemphigus*.

For several years the common Alder Blight has attracted me for various reasons, and has held my curiosity both because the migrants from the alder in September are indistinguishable from the migrant of *Pemphigus acerifolii* Riley, in July, and because there seemed to be no place in the life cycle of *Pemphigus tessellata* for a migratory generation. The apparent purposelessness of the September migrants from the alder seemed especially strange.

Perhaps a brief statement of the life cycle of *P. tessellata* upon the alder will emphasize this. We have with the first warm days in spring the hibernating generation, hardy, little, partly grown forms, coming up from under the leaves at the base of the alder where they have wintered, and establishing themselves at the alder tips in time for the first sap of the season. These, when mature, become the first of several similar successive generations of apterous viviparous forms. The last of these apterous viviparous generations in the late fall give birth to the hibernating young which completes an apparently sexless cycle for this species.