MICROSCOPY IN HORTICULTURE.

Scientific Training not Essential to the Effective use of the Microscope by the Florida Fruit Grower.

Paper prepared by Rev. C J. K. Jones, of DeLand, Fla., and Louisville, Ky., and read by the Secretary.

[SEE MINUTES PAGES 1 TO 6, ITEM 17.]

One of the greatest difficulties under which the farmer and fruit grower labors is the lack of definite knowledge as to the facts and phenomena attending the cultivation of plants and trees. In the orange industry, as conducted in Florida, the writer has found it difficult to get an accurate statement as to the nature of the various conditions under which the culture is conducted. He has heard the strangest reports, from all parts of the State, concerning the character and depredations of various predatory insects. He has been frequently alarmed at descriptions of old, and new diseases, that threaten to destroy our groves. Every exudation of sap has been construed into an infallible sign of foot-rot (mal di goma). In the days of the pruning madness he received the most startling declarations as to the histology and physiology of the orange tree. When it came to the chemistry of the soil; the action of fertilizers; the structure and action of roots; and the relations of leaves to the normal development of the tree, he found that every man was a law unto himself, and tried to be a law to his tree also.

The writer in no wise would even seem to reflect on the intelligence of his fellow horticulturists in Florida. On the contrary, after years of association with them personally, and through their many valuable articles in the horticultural journals, he knows that they are a class of men usually capable in their calling, as pertains to the practical side of fruit growing. The purpose of this article is not to criticise, but to call attention to the fact, that there are many problems in fruit raising, which require a method of solution more scientific in manner of investigation and treatment, than we have hitherto given them. When we shall have adopted this more scientific procedure in experimentation, and in observation, we shall arrive at more scientific, and therefore more certain results. This is not to intimate, much less to say, that there are not among us, men who are scientific. There are many such men, members of this Society. But the larger number of us horticulturists are not scientific in our methods of horticulture.

Am I in error when I say, that in our several communities truly scientific horticulturists are in the minority? The lack of scientific method has been much impressed upon the writer during the past fifteen months, as he has closely followed the many discussions on the condition of our frozen-down groves, and the best course to be pursued in order to resuscitate them. The great variance in the counsels offered has been due to the absence of an accurate scientific knowledge of the status of the
groves. Men who were most successful orange growers, when the conditions were normal, have been sadly "at sea" for the past year. Some have not yet come "within sight of land." Perhaps we are each, and all, somewhat to blame for this situation of uncertainty, in that, in the past, we have not insisted upon scientific methods for ourselves, and for our neighbors. They who knew should have imparted to those who did not know.

While on a visit to his grove in July, 1895, the writer asked several most successful growers, "have you used a microtome and microscope on these blighted and diseased tissues?" The answer was, "No." Perhaps at that stage of affairs sections of wood would not have revealed much, unless there had been previous studies of normal tissues in bud, bark, wood and root. Nevertheless it would have been instructive to some of us, not on the field, if we could have had a few microscope slides of various tissues made on the first morning after the February freeze. Especially valuable would it have been, if, with the slides of sectioned wood, there had been a short history of culture and fertilization.

The writer saved over two hundred trees, fourteen years old, budded on sweet stock. He attributes this, fortunate "salvage from the wreck," to the fifteen per centum high grade potash in the fertilizer he had used on his grove, which potash made a stronger cellular tissue. In the absence of testimony bearing thereon, he thinks the microscopic examination of tissue would have helped to decide the question.

Prof. Webber has demonstrated to us (see U. S. Dept. Agriculture Year Book, 1894, p. 183 ff) that fertilization has very much to do with the character of the wood and fruit of our trees.

In this connection it is pertinent to remark that we have been greatly dependent on the U. S. Dept. of Agriculture, and its skilled specialists for a large portion of the definite knowledge we have in our calling. I am sure we gratefully acknowledge our debt. But while so recognizing this debt, ought there not to be a deeply felt responsibility, that we shall also do something to help ourselves? We can not all be experts if we would. But we can do something in collecting data that shall be definite and reliable. We can be scientific. As has been said: "It needs no marvelous intellect, no special brilliancy to succeed in a scientific study; work at it ardently and perseveringly, and success will follow." Much of the data that we need must be collected by the microscope. The most of the enemies we have to fight, as the most of the secret processes, and their results, we have need to observe, are of the "Kingdom of the infinitely little," whereinto the unaided eye of man can not penetrate.

The simple microscope, in the form a single lens, magnifying ten or twelve diameters, is of great service. But to ascertain the facts concerning many an insect and fungus we may require a magnification of one hundred or more diameters. For this work a compound microscope is absolutely essential. For example the study of rusts on grain, the mildews on grasses, the smut of corn; in short the many diseases of field and garden crops, can be intelligently observed only by the use of the complete compound microscope. It was not until men commenced to use this instrument, that the diseases of plants began to be understood and received their first checks. Today the intelligent use of the microscope
combined with some chemical knowledge, is enabling horticulturists, the world over, to successfully cope with their enemies of air and earth, in form of insects, fungi and bacteria. The use of the microscope is, by many, looked upon as requiring such stores of knowledge and such expert skill, that they are deterred from making even a beginning of its use. It is true that the highest expert use of the microscope requires a large amount of technical knowledge. But the data we require in much of our work, does not call for more ability and skill than is easily commanded by the majority of horticulturists, who will give a few hours each week to study and work with the microscope. If we older men, burdened with "the toil and moil," can not find either the mood, or the time, then let the work be done by some of the bright and capable young men and young women of our homes. They will grow into the work and will like it. It would be a practical step in the right direction, if, at our succeeding meetings, we could have a working session with the microscope; at which the value of the instrument could be demonstrated. Such a session would make it very plain, that by the aid of a half dozen microscopes, or even one microscope in each one of our horticultural centers, intelligently used, we could answer for ourselves many questions, which we now send to Prof. Weber, or to Lake City Experiment Station, or to Washington. We can be, we must be, more largely "the arbiters of our own fate." He, who understands aright the practical use of the microscope, as has been said, "is endowed with a sixth sense." For us horticulturists, the one point of especial value in the use of the microscope in our calling, is that we shall make clear and definite to our minds whatever scientific information we may acquire. So important is this subject, that the writer begs leave to suggest, that at least each horticultural neighborhood shall have a microscope and its proper outfit.

We ought to be in position to, at least, make verifications for ourselves, of the facts and principles of our science. Such verifications would be the identification of all forms and effects of insect life which make hosts of our trees and plants. Again, we would gain a practical knowledge of the fungi and bacteria, which plays so important a role in the conditions of health and disease in our plants and trees. At first our studies will be unsatisfactory in immediate results. We shall find it slow work, and not be able to declare the nature and meaning of most that we observe. However, continued observation and study will eventually bring experience, and experience will inevitably result in intelligence and definite knowledge.

To aid any would-be learner of the more scientific aspects of agriculture and horticulture, the writer has prepared, as an appendix to this article, a description of a microscope outfit suitable for a beginner, and for all ordinary uses. There also accompanies this paper a bibliography of some of the most valuable and modern books pertaining to the science of our calling.

In conclusion allow me to say, that what I have urged in regard to horticulture applies equally to agriculture in every particular. The intelligent man who crops his land by the knowledge and methods which scientific men have demonstrated to be successful, is the man, who will realize that "seed-time and harvest shall not fail."

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Cooke (M. C.) Introduction to the Study of Fungi. Their Organography, Classification and Distribution for the use of Collectors. Illustrations, valuable. 360 pp. A. & C. Black, London, 1895. 1 Vol. 8vo. cloth. $4.00 (?)


3d edition. 1 Vol. 16mo, cloth. 75 cents.
Simmonds Tropical Agriculture. C. Scribner & Sons, N. Y. Importers. 1 Vol. $8.00 net.
Prof. True, significantly adds the remark "the diseases of oranges have not been reported upon to any considerable extent."

A MICROSCOPE OUTFIT.

In order to aid any person who may desire to inquire concerning a microscope outfit, the following illustrated suggestion is given of such an outfit as the writer deems suitable to the ordinary investigations of an agriculturist or horticulturist.

The instruments represented are made by the Bausch and Lomb Optical Co., of Rochester, N. Y., and are given below as they appear in the catalogue of this well-known and reliable firm. The writer owns two of their instruments and several of their first-class objectives, with which he has worked for several years, and therefore speaks from experience.
TT I—IMPROVED BARNES’ DISSECTING MICROSCOPE, (SEE CUT PAGE 113).

This microscope which costs about $3 will be found very useful for botanical or ordinary zoological work, as it combines all the essentials of a dissecting microscope, viz.: a good lens in a convenient holder with an ample stage, well illuminated; the whole on a firm base with immovable rests for the hands.

HASTINGS APLANATIC TRIPLET. Nos. 35 to 39.

For use as a pocket lens, the power 6.7 and 10 are especially recommended, the first, perhaps, superior in general utility, and the second a more convenient size. Nos. 36 and 37 cost $7.

CONTINENTAL MICROSCOPE.

This instrument is especially recommended on account of its moderate cost, $42.00.

AMERICAN TYPE MICROSCOPE.

The base is of tripod form and of brass. The bronze pillaris large and provided with joint for inclination. Coarse adjustment is by diagonal rack and pinion of long range. Fine adjustment is by micrometer screw, head of which is graduated, silvered and provided with indicator. The main tube has two graduated draw-tubes, sliding in cloth-lined main tube. The stage has concentric, revolving motion and clips. The mirrors are plane and concave and of large size, these and substage being adjustable separately on their respective bars, with
circular bearings graduated and silvered. This instrument is made in three forms; the price ranging from $72.00 to $170.00.

The writer suggests the purchase of the larger of the two instruments herein named, wherever the purchaser can afford the slight advance in price. The reason for this suggestion is that the larger instrument admits of some accessories for advanced work, not provided for in the smaller instruments.

NO. 2021 MICROTOME.

This instrument is for making sections of wood, stems, leaves, etc. Any good sharp razor ground flat on one side will do as a cutting tool. Razors for the purpose are furnished by the makers of the instrument at a cost of $1.10 and upward.

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**FERTILIZERS AND FERTILIZING.**

Discussion under topic "Fertilizers."

[SEE MINUTES PAGES 1 TO 6, ITEM 45.]

L. Montgomery: I have no report, and all I can say on Fertilizers is my experience. I have been in the habit of compounding my own fertilizers and making them after a formula I published in the Farmer and Fruit Grower some years ago. I use high grade potash, nitrate of soda, phosphoric acid. Making a fertilizer of about the following analysis: potash 16 per cent, ammonia seven per cent, phosphoric acid four per cent. I am not sure I am giving it correctly as I have not my notes with me. I have been well satisfied with that, and have used it on some of my groves extensively.

C. A. Bacon: I would like to ask Dr. Montgomery about his stable manure. At the last meeting I attended here that question came up and there seemed to be quite a variety of opinion in regard to the use of it for orange culture and other plants. North we stable all our stock, cattle and

*NOTE—The subject of Fertilizers and Fertilizing, which was passed at the 1896 meeting without further consideration than is given in the discussion which appears under the above head, has been fully covered at previous meetings. For further information on this subject see previous published Annuals of the Society.—The Secretary.