PHOTOMICROGRAPHS WITHOUT A MICROSCOPE.

BY C. H. CLAUDY.

Hitherto, when that division of the Department of Agriculture which has to do with seeds desired to illustrate seeds in its publications, it had recourse to a drawing made by an artist with the aid of the microscope and the camera lucida. Although both accurate and beautiful, the preparation of these drawings entailed a great deal of time and cost a great deal of money.

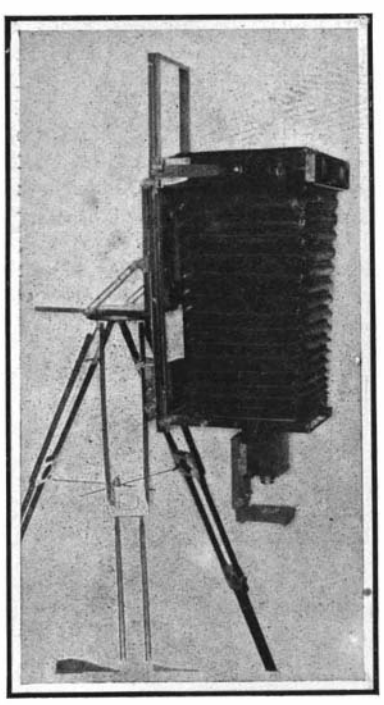
From time to time, attempts were made to photograph seeds in an enlarged perspective, so that the labor of drawing them could be dispensed with. The experiment was made both with the camera alone, and with the camera and microscope combined. In the one case, if the magnification was sufficient, the detail was not sharp enough; in the other, the magnification, even when low for a microscope, took in too small a field and was also in other ways quite unsatisfactory.

Prof. F. Lamson Scribner, ex-chief of the Insular Department of Agriculture in the Philippines, botanist and agrostologist, set himself the task of devising a simple and effective apparatus, with the result that the one which he perfected and is now used gives the most perfect results.

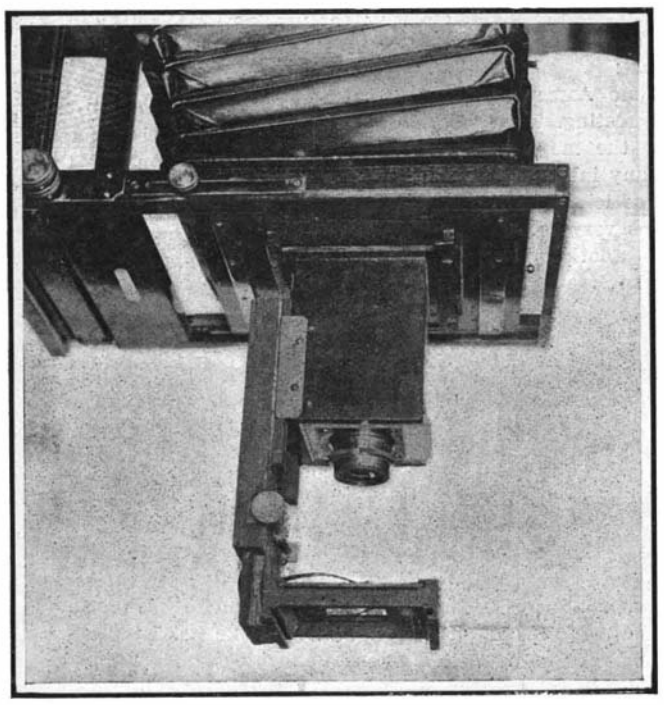
It consists of an ordinary view camera, with a long bellows. A Goerz lens, Series III, of 2⅜ inches focus, is used, also a stage, carying a ground glass and a plane glass movable with a rack and pinion, and a box extension carrying the lens. This arrangement is shown in the accompanying photograph. When a lens is distant just twice its focal length from an object, measured when in focus on infinity, the image reproduced in the camera is exactly the natural size of the object at the plane from which the measurement is taken. That is, when the lens is 4¾ inches from the glass stage, on which some seeds are laid, the image of the seeds will be formed 4¾ inches behind the lens and of life size.

For every additional unit of focal length that the plate is withdrawn, the magnification is increased by one diameter. That is, if the lens and plate are distant from each other 4¾ inches plus 2⅜ inches, and the stage carrying the seeds is moved up until the image is sharp, the magnification will be two diameters instead of life size. To obtain, therefore, a magnification of nine times, the lens must be 9 x 2⅜ + 2⅜ inches distant from the plate, or a total of 23¾ inches. This distance, of course, called for a lengthy exposure. This was given, with a normal north light, to the amount of ten minutes with a stop in the lens which is normally sixteen. It must be remembered, however, that the lens is here working at a focal length ten times its normal and that the stop is therefore one hundred times smaller in fact than its designation indicates. For instance, in an 8-inch lens, a 1-inch stop is *f*/8. The same lens at ten times its focal length and with the same stop would be working at *f*/80.*F*/80, which is equal to *U.S.* 400 (80 × 80 ÷ 16, meeting point of two systems, equals 400) and *f*/8 is equal to *U.S.* 4, and 4 is to 400 as 1 is to 100. Comparison is best made in the U.S. system, because it refers to areas of stops, while I.F. system refers to diameters. Therefore a long exposure is made necessary in the above instance, the stop sixteen being in reality *f*/160 or U. S. 1600.

Shorter exposures would do the work in some sort of manner, but it is essential in these photographs to show the detail in the shadows, which requires more time. The above time and magnification is of course but one instance, other seeds, of different colors or with a black background, requiring longer time, or if the magnification is less, a shorter time.



Complete Apparatus for Photographing Seeds.



Details of Apparatus, Showing the Stage and Seed Holder, Also the Rack and Pinion.

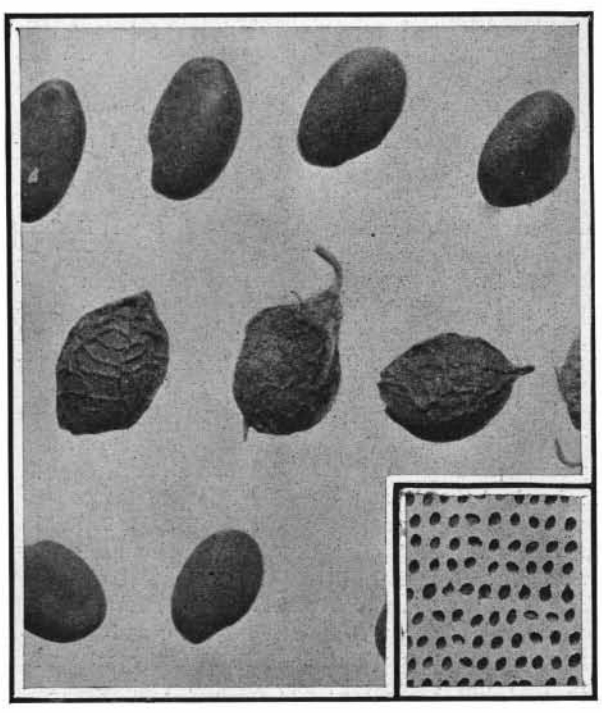
It is essential, of course, with such a long exposure, that everything about the apparatus be absolutely rigid; hence the tripod stay and the perpendicular position of the apparatus, which insures that the seeds themselves do not move.

In the accompanying photographs of various seeds the comparison between a good and a poor lot of seed is made manifest. In poor seed, the seeds themselves are neither so vigorous nor so perfectly formed, and numbers of other seeds, weeds, and foreign varieties are easily discerned. While in making accurate percentage statements of the amount of pure seed and the amount of weed and other impurities present, the usual method of counting a measured amount of seed by an expert, and actually separating the good from the bad, will be followed as before. For preliminary comparisons, or where a large number of samples must be compared in a short time, the photographic method offers great advantages. Besides this factor, the photograph is in itself of considerable value, as it provides a permanent record of the impurities of any particular variety of seed.

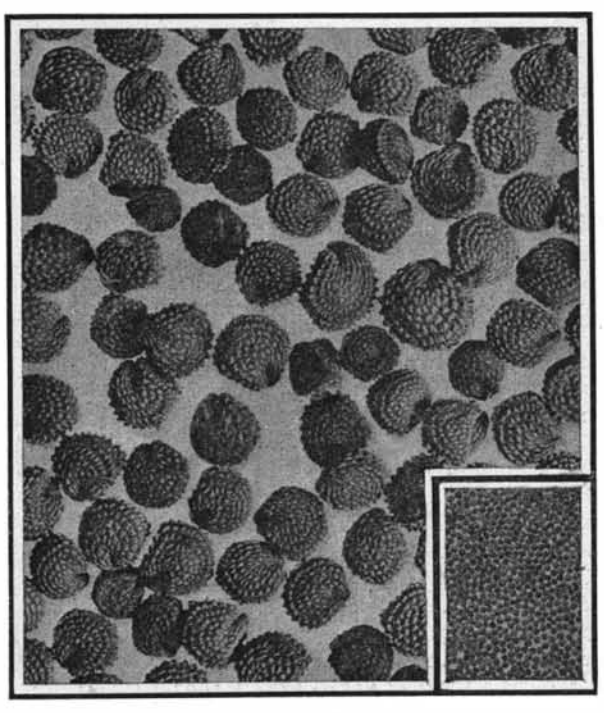
There are at present supplied to seedmen or any one who wishes to make use of them, cases of bottles containing seeds of many varieties. The Department of Agriculture requires the applicant to pay for the case and the small bottles, which amounts to about a dollar and a half, but supplies the seeds, labels the bottles, and ships the case complete. When a new variety of seed is to be located, the seedman does it by comparing it with the known pure seeds in his collection. Obviously, this is a method which takes time, tiny seeds in a bottle and equally tiny ones under the glass being difficult subjects for comparison. Drawings of seeds in printed form have been used, but no matter how perfect the drawing, it has been found that they are not easily recognized when compared with real seeds. With the photographs, however, this is not the case, and it has been suggested that a report be published which will contain plates of seeds, magnified, as in the present samples, and made after Prof. Scribner's method.

In the government exhibit at the Portland Exposition, the seeds exhibited were shown under microscopes. This method was interesting in itself, but required considerable time on the part of the visitor and allowed but a small number to view the exhibit at one time. At Jamestown the seed exhibit has been supplemented with these photographs, which show at a mere glance the work of the seed department, and prove an interesting and instructive feature of the exhibit. Prof. Scribner, who was in charge of that portion of the exhibition at Portland, now holds a similar position at Jamestown. He started to make these photographs with the idea of exhibition purposes; that they have resulted in such practical value to seed work is of course a matter of pride and satisfaction with him. The seed department is much delighted with the photographs, and the writer was informed by Prof. Duval of the Pure Seed Investigation Department that their value was as yet unknown, inasmuch as new ways of using them were being constantly thought of. He cited as an examplo the training of a new workman in seed examination and seed identification. By means of the photographs, the new workman can easily recognize seeds under the microscope, while if compelled to depend upon drawings, no matter how perfect, the recognition is not nearly so quick or so accurate. This is but one of the many uses to which the photographs are put. It is hoped in time to obtain a complete collection of photographs of all American seeds, in pure and impure states, for permanent record in the department. The whole idea marks one more step in the all-embracing importance of photography in the arts and sciences.

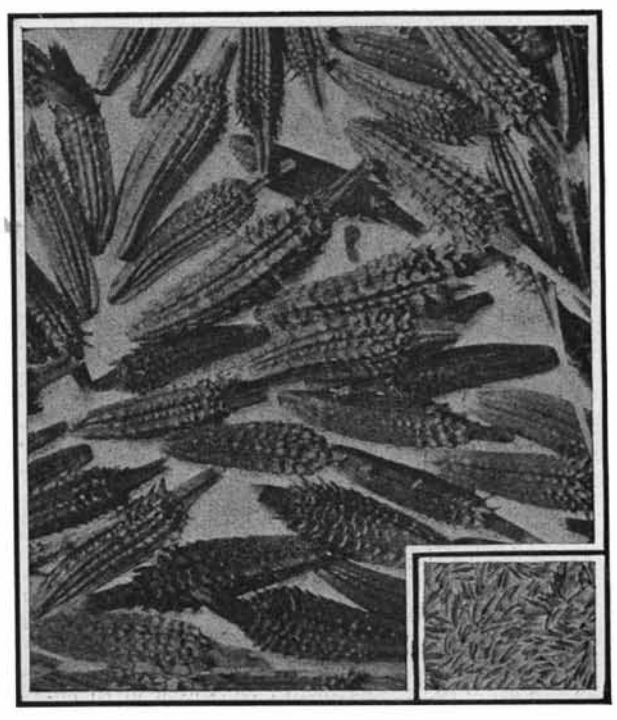
Bronze Varnish for Leather.—10 parts of fuchsine and 5 parts of methyl-violet are dissolved in the water or sand bath in 100 parts of 90 deg. alcohol, then 5 parts of benzoic acid are added, after which it is allowed to boil from five to ten minutes, until the mass has assumed a brilliant gold bronze color.



Sweet Clover Seed, Natural Size and Enlarged.



Chickweed Seed, Natural Size and Enlarged.



Dandelion Seed, Natural Size and Enlarged.

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