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SYNOPSIS OF A COURSE IN MICROSCOPY FOR PHARMACISTS.

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The following synopsis is intended as a guide for a course of home study, and not such work as can be followed in a College of Pharmacy, where students receive individual instruction, and have the benefit of object lessons. The nature of a paper for this organization must confine it to limits which will prevent my giving an introduction to the subject.

Unfortunately for the pharmaceutical profession, we have no works upon the subject of Microscopy which can be taken as text-books for home instruction. There is a rich supply of works on Microscopy as applied to medicine; several volumes have been written for the microscopist who works in Chemistry, and the number upon the use of the microscope in the study of Botany is not small; we even find works devoted to the application of Microscopy in Petrology, and I hope that it will be at no far distant day when the literature of Pharmacy is enriched by suitable works upon Microscopy for the use of the druggist.

In order to fully appreciate and take advantage of the Microscope as applied to Pharmacy, the druggist must be quite proficient in Botany and Pharmacognosy, in other words, he must have the advantage of home reading or a Pharmacy College training. At the present time all of the leading Colleges of Pharmacy in this country have departments devoted to instruction in microscopical work, but those who graduated a few years ago did not have the opportunity of such training. Many of those who graduate at present, overlook the value of Microscopy while they are students, and defer the study until they have left college and engaged in business.

Although the educated pharmacist has quite an advantage over his less fortunate brother when he takes up the study of Microscopy, the same as he has in the daily pursuits of his vocation, still the druggist whose opportunities for study have been very limited, can advantageously follow out a course of home study in Microscopy. The work with the microscope can be taken up in connection with Pharmacognosy, Chemistry and other studies which the home-educated pharmacist must pursue.

One of the branches of an elementary education which is usually overlooked in our Colleges of Pharmacy is Physics. I find that the average student has received but a very meagre training in this branch during his school days. An understanding of the general principles of physics is of value to every individual, and especially so to the pharmacist. In order to intelligently work with the microscope and comprehend the principles upon which it is constructed, a person must be familiar with at least that branch of physics known as Optics. Therefore I recommend that every person taking up a course of study in microscopy shall first familiarize himself with optics. The chapter upon this subject given in the works on microscopy is scarcely sufficient for the purpose; it is much better to study some work devoted to the subject of physics. Chapter VII in Norton's Natural Philosophy is a very good course upon the subject. The chapter upon Optics in Steel's Fourteen Weeks in Physics is also of value.

After mastering the principles of Optics, it will be in place to take up the study of the microscope as an optical instrument. The student will soon learn that microscopes are divided into two great classes: Simple Microscope and Compound Microscope.

It is best for the home student to confine his first work to that which can be accomplished with the simple instrument. It is advisable to purchase Manipulations of the Microscope by Bausch, which is a fifty-cent book; also a volume entitled, How to Work with the Microscope, by Phin; a new edition has just been issued, and sells for one dollar and twenty five cents per copy. Simple microscopes are not very expensive, so that a druggist can afford to purchase a good one with three separate lenses; they range in price from twenty-five cents to two dollars and fifty cents.

After purchasing the instrument and reading what is said upon the subject in the works just mentioned, the druggist is ready to commence practical operations. It is not advisable to begin by studying drugs and objects the structure of which is not familiar, but examine such things as the integument on the palm and back of the hand, the print of the newspaper, the web of cloth, and similar familiar objects. After the student has become familiar with the changed appearance of such objects when seen under the simple microscope, he can take up less familiar substances, such as seeds, leaves, roots, powders, crystals, etc. The hairs found upon many of the vegetable drugs are very interesting and instructive, as they serve as one means of identification of the substances. After considerable practice in this line of work, the student is ready to take up the alphabetical list of substances in the U. S. Pharmacopœia. A simple microscope will enable him to observe the microscopical character of a large number of this list. The hairs on nearly all of the leaves are characteristic. The warts, wrinkles, ridges, hairs, scales, scars, etc., on branches, barks, rhizomes, roots and other parts of plants, often serve as a means of identification. Those drugs which consist of whole or parts of flowers are also suitable for microscopical examinations. There are also some of the pharmaceutical preparations, such as mercurial ointment, mercury with chalk, etc., where the Pharmacopœia directs the use of a microscope in testing their value.

The student should not become too ambitious and anxious to handle the compound microscope before he is perfectly familiar with the use of the simple instrument.

There are other uses in a drug store for the simple microscope than the examination of drugs; I may mention its convenience in making out the number of a prescription given upon a soiled label, and numerous other opportunities will present themselves to the observing pharmacist.

When the pharmacist is ready to buy a compound microscope, it is advisable to purchase a good stand, if it can possibly be afforded. This will enable him to add accessaries in the future as time, inclination and financial condition may suggest or permit. The cheapest compound microscope which can be made of service in a drug store will cost about twenty-five dollars. The instrument known as the Library Microscope, manufactured by the Bausch & Lomb Optical Co., is supplied with one-fourth inch and one inch objectives, which give a magnifying power ranging from eighty to three hundred and seventy-five diameters; this microscope sells for twenty-five dollars, and is as cheap a one as I would advise any pharmacist to purchase. Fifty dollars will secure a very fair outfit, giving one-fifth and three-fourth inch objectives, which are the ones most generally used by the pharmacist. If the student can possibly afford it, it is better to invest about seventy dollars, and secure a good stand with one-fifth and three-fourth inch objectives. Such an instrument is sufficiently complete to admit of the use of almost any accessaries which a pharmacist will ever have occasion to use. As an example of a microscope for this price I will mention the Griffith Club Microscope, which is very convenient for the use of druggists. Unless a pharmacist feels inclined to be lavish in the investment, it is not necessary to purchase a microscope costing more than from seventy-five to one hundred dollars. Of course the accessaries may amount to an equal sum, but it is not advisable to have too many of them, while learning to use the instrument.

When commencing work with the compound microscope, it is better to learn to manipulate the stand with eye piece and objectives before any accessaries are added. The books which were recommended for use in studying the simple microscope are still more serviceable and essential when it comes to manipulating the compound instrument. In addition it is advisable to read one or both of the microscopical journals published in this country: *The Microscope* of Trenton, N. J., and *The American Microscopical Journal* of Washington, D. C. The subscription price is one dollar per year, the same for each publication. The student will also naturally be interested in the departments devoted to microscopy in the various pharmaceutical journals.

In commencing work with the compound microscope, it is best to follow the same plan as suggested for the simple microscope, and first study familiar objects. Among these suitable for the compound microscope we have the various fibres, such as wool, silk, cotton, and linen: every microscopist should be able to identify each one of these fibres. Small seeds, hairs, and even the dust which collects in a room, are suitable for study. When it comes to the study of less familiar objects, we have those mentioned while referring to the simple microscope, and in addition to the list come various kinds of starch grains, powdered drugs, and other substances which require no section cutting in order to be examined.

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It is not advisable to attempt the preparation of permanent mounts for the microscope until the student becomes quite familiar with the examination of objects. By this time another work will prove of service to the pharmacist, and that is The Practical Microscopist, by Davis, the price of which is two dollars and fifty cents. As an aid and guide in the study of powders, I call attention to articles by Hans Wilder, entitled "Microscopical Examination of Powders" (*American Journal of Pharmacy*, June '90, page 278, July, '90, page 332.) Another source of valuable information on the subject is Bulletin No. 13, issued by the Division of Chemistry of the Department of Agriculture of the government; parts I, II, III, IV, and V, are all of interest to pharmacists, but it is part II that treats of the examination of powders. The bulletin is entitled "Food and Food Adulteration," and can be obtained by addressing the Secretary of Agriculture. These publications by the Department of Agriculture are intended for the use of the citizens of this country, and I hope that the pharmacists will see that good use is made of them.

If the student can afford the expense of a polariscope (which costs from twelve to twenty dollars, and can be used with the seventy-five dollar outfit), it is advisable to purchase one when this stage in his study has been reached. The polariscope is especially serviceable in the examination of starch grains, crystals, and many other substances.

The student is now ready to take up the work of mounting specimens for examination and preservation. It is best to commence with the preparation of dry mounts, such as are made with the use of paper covers. Then come dry mounts with the use of cements. I consider a turn-table essential to the outfit of any one who prepares permanent mounts; it not only enables him to make more elegant preparations, but saves time and trouble. After learning to prepare dry mounts, the use of balsam, both hard and soft, is next in order. Those who have access to the Companion to the U. S. Pharmacopœia will find the chapter on the subject of Microscopy very instructive when they come to the use of balsam, glycerin jelly, or glycero-gum, and other mounting media which require similar technic. The use of balsam should be studied before passing on to mounts made in liquids. The preparation of mounts in liquids is more difficult than in the foregoing media. Glycerin, carbolic acid and creosote water, castor oil and other liquids used in mounting, all require about the same work, and can be studied together.

After gaining proficiency in mounting specimens, the student should take up the work of section-cutting. It is best to commence with free-hand work, such as cutting soft vegetable tissues imbedded in elder-pith. It is very convenient to be able to make such sections, and sometimes circumstances are such that it is necessary to make them free-hand with a razor, or not at all. If the student does not practice this before he commences the use of the Microtome, he will never learn the art. An ordinary potato is a very good substance to practice upon for free-hand section-cutting. The first work of the Microtome should be on such substances as rhizomes of ginger, calamus, podophyllum, etc., which can be imbedded in Paraffin or similar imbedding substances.

We next come to the section-cutting of hard vegetable tissues like Pareira Brava, which requires special soaking, but no imbedding. Cutting sections of fruit stones, coral, minerals, etc., are not in order. They require the use of a saw and grindstone.

The student is now ready for the more difficult task of sectioning animal tissues and spongy vegetable substances, which are best imbedded in celloidine. I find that it is better for the student to learn to make sections and carefully handle them, before he attempts to mount specimens which require sectioning.

An artistic talent is not the good fortune of every one who studies microscopy, but any one can learn to draw more or less correctly what he sees under the microscope. The practice teaches the student to closely observe what he sees. I advise the student to commence drawing at the first lesson.

The use of the microscope in urinary analysis is work suitable for the pharmacist, but requires special instructions from teachers or books.

It is the duty of every one who works with the microscope to start a cabinet of permanent mounts. Whenever the microscopist is mounting a substance, he should make several preparations, so that he can select the best one for his cabinet and exchange the less desirable ones with his brother microscopists. For use in examining drugs, it is well to have mounts of the true drugs and also of substitutions which are known to be used as adulterants.

Pharmacists who have not already done so, should study the illustrations of the microscopic appearance of drugs as given in Maisch's Organic Materia Medica and the Dispensatories, as well as other works on Pharmacognosy.

The pharmacist who has time and inclination will profit by work in photo-micrography. An article on this subject was presented to the Association last year by W. H. Krug and A. B. Stevens (A. P. A. Proceedings, '89, page 84).

Another duty which devolves upon the microscopist is to associate himself with local organizations. This can be done in every case where there are two or more pharmacists working with the microscope.

If space would permit, it would be interesting to dwell upon the large field for individual and original work which presents itself to the student who makes use of the microscope in Pharmacy. The pharmacist who accomplishes most with the microscope will be the one who sets apart a certain amount of time each day or week for the use of the instrument. There is an infatuation about the use of the microscope which sometimes leads the microscopist to devote more time to the subject at one sitting than can be afforded, so that the instrument must be set aside and neglected for some time to come. Therefore I advise every pharmacist who takes up the study of microscopy to lay out a schedule of work, and follow it as closely as circumstances will permit.

In conclusion, I must state that system and order are of as much value to the microscopist as any workman. It is best to have a table, closet or box for the accessaries and reagents, so that they may be kept together. The microscope is very conveniently kept under a bell-glass, so that it is always ready for use at a moment's notice.