TEACHING PLANT CHEMISTRY.*

BY NELLIE WAKEMAN.

The subject of this paper is sufficiently broad to cover a number of papers of the necessarily limited scope of this one. Indeed, volumes might well be written upon the subject without exhausting it, for the subject would develop as it was discussed, continually presenting new phases for discussion, being practically unlimited.

Three main lines of thought, however, present themselves when the subject is considered briefly, (1) the value of the subject; (2) the materials for study; and (3) the methods of presenting the subject. It is my intention to touch upon the first two lightly, devoting the greater portion to the teaching of plant chemistry as it is actually carried out at the University of Wisconsin.

There can be no question of the importance of plant chemistry. The world is beginning to realize the importance of chemistry in general and of the chemist. Never have we heard so much of the value of chemistry as during this war. Numbers of papers have been written and addresses made upon "Chemistry and the War," and we all realize that though eventually the war will be won by the side that can put the largest armies of trained men into the field, yet the armies of to-day would be practically powerless without the chemists back of them.

We are all familiar with the slogan "Food will win the war," and when we stop to think of it we recognize our dependence upon the little chemists of the wheat fields, the sugar plantations, the cotton fields, and all the other fields, where, all unnoticed, there is happening the ever recurring miracle beside which the miracle of the loaves and fishes fades into insignificance, the daily miracle of the conversion of air and water into food for all living things. A simple chemical reaction it appears, $6CO_2 + 6H_2O = C_6H_{12}O_6 + 6O_2$. Our eyes are holden and we see no miracle. But, if Germany had mastered the mysteries of this reaction, the combined armies of all the world could scarcely hope to bring her to her knees; if England had mastered it, all the U boats that could ever be built would never be able to starve her out; and if we had mastered it, we would not now be limited to black bread and two pounds of sugar a month. No, there is no question of the importance of plant chemistry; but it has been neglected.

Important as the subject is in general, it is of especial interest to pharmacists for two reasons, (1) so much of our materia medica is derived from plant sources, and (2) so many of the advances hitherto made along plant chemical lines have been made by pharmacists.

The material for study is inexhaustible, both for practice and for research. Every plant drug of the Pharmacopoeia, every weed by the wayside, may be made to serve as material for some line of experimentation or investigation. The subjects open for investigation are almost as varied as the material obtainable. Moisture, ash, enzymes, carbohydrates, resins, oils, alkaloids, tannins, pigments, proteins, these are some of the larger classes of subjects, any one of which will furnish valuable experience for the beginner or a lifetime of work for the investigator.

For a good many years, how many I don't know, a three-credit course in plant chemistry, throughout the senior year, has been required of students in pharmacy

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at the University of Wisconsin. This course, as the catalogue states, is supplementary to pharmacognosy, which is given as a two-credit course at the same time. The two courses together are designed to give the student as thorough a knowledge as possible, in the time available, of the U. S. P. plant drugs and their constituents. The course in plant chemistry is divided, somewhat arbitrarily, into two parts, the work of the first semester being of such a character that a knowledge of advanced organic chemistry is not required, while in the second semester definite chemical compounds, requiring more chemical knowledge, are studied. This division is necessary in our work at Wisconsin, because a large portion of the class is always made up of students of the two-year pharmacy course who are at this time but beginning the study of organic chemistry. According to this division, the work of the first semester is devoted principally to the isolation and study of constituents that are more or less natural mixtures. The old-time grouping of plant constituents is followed: oleoresins, resins, volatile oils, etc. Starch is isolated from potato; the fixed oil of almonds is prepared; oleoresin of pepper is made and piperin separated from the oleoresin; the distinction between a natural and a galenical oleoresin is noted and a nature oleoresin such as balsam of copaiba is separated into its constituent resin and volatile oil. A study of the water content of plants and drugs is also made and the rôle water plays in the biochemical processes of the plant, photosynthesis and enzyme action, is studied, as well as the significance of water in the curing of drugs.

A considerable amount of quantitative work is done during the first semester. Moisture and ash determinations are made; the saponification and acid numbers of resins and fixed oils are found; and iodine absorption numbers are determined.

Throughout the first semester all material isolated that would serve as illustrative material for the study of definite chemical compounds during the second semester is carefully saved. In this way the continuity of the work is preserved and the interest increased. Thus, the marc from which the fixed oil of almonds was obtained serves for the isolation of amygdalin when carbohydrates and glucosides are studied; and the piperin removed from the oleoresin of pepper furnishes material for an interesting set of experiments when the subject of alkaloids is reached.

During the first part of the second semester considerable time is devoted to the study of volatile oils,—not merely because the volatile oils are in themselves interesting and important pharmaceutical products, but because nowhere else in all the realm of chemical materials is there so readily available material illustrative of so many important organic reactions. Here we find saturated and unsaturated hydrocarbons, alcohols, acids, esters, ethers, aldehydes, ketones, and phenols in a form convenient for study. This work is placed at the beginning of the second semester because it has been found that at this time the students, who have just completed a five-credit course in organic chemistry, are benefitted by a review of the principal organic reactions, before they have had time to forget them, and also because much of the work upon volatile oils can be carried out most advantageously, especially by beginners, when the weather is cold.

During this semester, as in the preceding one, plant products are studied as members of more or less natural groups, carbohydrates, glucosides, tannins, pigments and protein products follow the volatile oils, being taken up, so far as possible, from the standpoint of composition. In all of this work pharmaceutical materials are used, so far as practicable, for illustrative and experimental purposes. This choice of material is governed more by pedagogic than pharmaceutic reasons, the students being ordinarily most interested in pharmaceutical materials. Whenever the point in question could be better illustrated by material other than pharmaceutical, however, there is no hesitancy about introducing it. In any case, whether pharmaceutical materials are used or not for purposes of illustration, the aim is always to make the reaction as broad in its application as possible. For while it is good for a student to be able to find the ester and the alcohol content of oil of peppermint for example, it is better for him to know that a chemical principle is a natural law and that the principles of condensation and hydrolysis involved in these reactions are always the same whether they apply to the making of soap, the manufacture of perfumes, of collodion, of dope for airplane wings, of artificial silk, or any other of the countless similar reactions which take place in the laboratory, the manufactory, the plant organism, and our own bodies.

The work of the classroom and the laboratory are carefully correlated; and the students are encouraged to read as widely as possible. To facilitate this reading a list of references, together with suggestive questions and topics for discussion, follows each chapter of the "Guide" with which the students are provided. This list is supplemented by reference to timely subjects, usually made orally in the classroom or laboratory, and afterwards posted on the bulletin board. A collection of selected books is kept for ready reference in a small reading room contiguous to the laboratory; for though the students are encouraged, and even required, to constantly consult books in the general and departmental libraries, much time is saved by keeping some of the most useful where they may be readily available during the short periods of waiting which inevitably occur in every chemical laboratory. Another small collection, chiefly duplicates of books in the general library, is to be found in the instructor's office. These books are loaned to the students upon request. This has proved to be one of the most effective methods for securing the desired reading. Whether or not the student selects these particular books in order to advertise to the instructor his interest in the subject is immaterial. The desired end is accomplished and the student reads. Even if he reads but little, he handles the book, carries it home, knows what it is about and where he can find information on the subject. This is perhaps, after all, the main thing, for it is much more worth while to know where to find a great deal of information upon a large number of subjects, than to have our minds crammed to their limited capacities by facts about a few things. The educated man or woman has better use for the brain than making it a store house for facts. An encyclopaedia is better and more reliable for that purpose.

An important part of the work of this course is the note book work. The note book is kept in two parts, one devoted to laboratory experiments and the other to the answering of questions and the discussion of topics suggested by the Guide. The reading of note books, though something of a drudgery, should not be neglected, as it is one of the best methods for determining whether or not the students are getting what they should from the course. Furthermore, since the note book is the student's best, and most frequently used, book of reference, it should be carefully corrected.

The course in plant chemistry, as a whole, has been found most useful. It is interesting; it is practical from the standpoint of both chemistry and pharmacognosy, and it carries with it more of general culture than almost any other course in the curriculum.

ALCOHOL—ITS FUTURE.*[1]

BY A. B. ADAMS.[2]

One of the subjects uppermost in the mind of the pharmacist to-day is alcohol. It is immaterial whether he is a large manufacturer or a small retailer. He wonders—how he can get along at present; what has the future in store?

Less than a year ago, with the suddenness of a bursting bomb, the prohibitionists won a great victory, and the manufacture of beverage spirits ceased. As alcohol is necessary for manufacturing purposes, regulations were issued by the Internal Revenue Department, under which non-beverage spirits could be obtained. These regulations are undoubtedly not perfect, and it will take years to make them so—if ever. To the pharmacist who was accustomed to buy and sell alcohol (and the vast majority never knowingly sold it for beverage purposes) it seemed an invasion of his rights to say that he has got to give bond, etc., can only sell at retail the medicated articles, regardless of the fact that the physician may not like any of the formulae for rubbing purposes. The physician, in turn, thinks he is abused when he cannot get a small quantity of the pure ethyl alcohol, for a specific purpose, without giving bond.

The manufacturer must be careful that all the private formulae he compounds conform to his sworn statement as regards medication. All of this is decidedly harassing. But these are harassing times and we all must put our shoulders to the wheel and help. Some of you have probably complained because your permit was refused or delayed for some reason; but see the other side—that of the other humans just like yourselves who have been directed by Congress to enforce the law of October 3, 1917.

One application was made by a duly credited physician to the Collector of Internal Revenue for ten gallons of alcohol and ten gallons of whiskey with which to treat his patients, "and please hurry the permit for the whiskey." A sanatorium made application for spirits which was to be used untreated for their patients. Such a place would soon have been doing a large business if the permit had been granted—which it was not. This is something of the other side. If we are to have National Prohibition after the war, and personally, I believe we are, then non-beverage alcohol is with us to stay. The thing for each to do is to try to the best of his ability to obey the spirit of the law and assist the Commissioner of Internal Revenue in the proper carrying out of the law given him to enforce.

Alcohol is necessary to the pharmacist. Sometimes he is able to make something else do fairly well, but that is about all. Tincture of Jamaica Ginger has been

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[1] Mr. Adams desires it to be understood that any expression in this paper is his personal opinion, and not an official one. This paper was written before the war had ceased, therefore some statements are not applicable to present conditions; there are, however, suggestions embodied which may prove of value.—EDITOR.

[2] Chief Chemist Internal Revenue Bureau.