A different indicator than that used in the United States Pharmacopœial assay of total menthol and menthyl acetate was used in the analysis of these western oils. The regular U. S. P. assay was followed in every other respect excepting this one; the indicator, phenolphthalein, was changed for phenol red. It was found in the determination of menthyl acetate and total menthol that phenolphthalein was not very satisfactory due to the fact that its colorless acid reaction was masked by the yellow color of the saponified oil. The characteristic color of an acid reaction to phenolphthalein should of course be colorless; because of the covering up of the acid reaction to phenolphthalein the end point is difficult to determine. Of the various other indicators used phenol red was found to be the most satisfactory. It gives a pink or red color, according to the concentration of the indicator, when alkaline, and a canary-yellow when acid. This yellow color shows up very distinctly and is not in any way interfered with by the color of the saponified oil. It is also a very sensitive indicator, one drop of either acid or alkali changing the color completely from pink to yellow, or vice versa.

In all ten samples analyzed the percentage of menthyl acetate and of total menthol ran very high as compared with the eastern oils of this country. The western oils assay more nearly like the Japanese and European oils. Perhaps western climatic conditions are responsible for the high menthol and menthyl acetate content. It has been shown by Umney and others that the climate and soil both have a considerable influence on these two constituents and it is thought that such is the case in Oregon and Washington. The air is very humid in both of these states throughout the summer and there is not the hot drying effect which is found in some of the eastern localities where peppermint is grown. This humid climate is probably one of the factors that cause the large yield of oil and the high percentage of menthol and menthyl acetate in the peppermint oil of the Northwest.

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CHEMICAL EDUCATION IN PHARMACY SCHOOLS.*

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The schools of pharmacy holding membership in the American Conference of Pharmaceutical Faculties offer two well-defined courses. The first course covers a period of two years and is especially intended to train students for the intelligent practice of retail pharmacy, *i. e.*, the filling of physicians' prescriptions and the manifold other duties demanded of the pharmacist of to-day. The second course, which covers a period of three years, is intended to prepare students for the fields of analytical and manufacturing pharmacy, food and drug analysis work, etc. Many schools of the larger universities, however, offer advanced courses leading to the bachelor's, master's and doctor's degrees in pharmacy. The chemistry to be taught in the two-year course will be the chief consideration of this paper.

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The field included by pharmaceutical chemistry is very extensive, and, in a broad sense, may be defined as the chemistry of all products used as medicines. One immediately realizes that such a field requires a thorough grounding in fundamentals of inorganic and organic chemistry, in addition to the application of the science to pharmacy.

There are essentially two great dangers in the teaching of chemistry in pharmacy schools; first, the danger of making the course so general that it loses all of its pharmaceutical application and consequently the attention of the student; the second danger is the strictly applied course, in which the student fails to catch the vision of general chemistry and ultimately his chemical education becomes stinted by the boundaries of pharmacy.

There are many advantages and disadvantages that may be cited by making a careful analysis of both the general and applied methods of presenting chemistry to pharmacy students. The general method, which is of course the teaching of arts and science freshman and sophomore chemistry, gives the student a broader vision of the science and in many ways establishes a definite relationship between chemistry and the every-day life of the student, which is quite impossible to do when teaching applied chemistry. General chemistry has a cultural value that is lacking in the applied science and has an intrinsic value when wanted for use as college credits in academic schools and for premedical work. The outstanding disadvantage, which partially overshadows the advantages mentioned, is that the average pharmacy student fails to make the connection between the general science and those parts which are important pharmaceutically and very often puts the emphasis in the wrong place. Then again, general college chemistry in many instances is incomplete for pharmaceutical purposes. Thus the production of disodium hydrogen arsenate is of utmost importance to the pharmacy student and yet only mentioned in passing in general chemistry courses. Other cases could be cited which would show how this type of incompleteness of general chemistry would severely jeopardize the education of the pharmacist.

The teaching of strictly applied pharmaceutical chemistry is, in a broad sense of the word, an injustice to the student unless the course be called pharmaceutical chemistry and not just chemistry. Without the general view of chemistry the student not only misses the viewpoint of the chemist but is likely to think that the sole purpose of chemistry is to serve the pharmacist. This applied chemistry has little cultural value and is not usually accepted for credit in academic or premedical schools. Thus, if a student having completed a two-year pharmacy course, in which strictly applied chemistry is taught, wished to get the degree of bachelor of arts, he would find it necessary to repeat a large amount of the work done in chemistry in order to secure proper credit for it.

Enterprising pharmacists, however, have suggested a loophole to this serious chemical dilemma, which in the author's experience in the School of Pharmacy of the University of Maryland has proved most successful in obviating the above-mentioned difficulties. It was pointed out that the objections to the general and applied methods of teaching chemistry are caused by extremes in both directions. This being true, if the lecturer teaches general chemistry and presents the point of view of the chemist and the director of the laboratory director be a pharmacist, both may go as far as they like in their particular fields and the ultimate outcome would be a student, both generally and pharmaceutically developed in chemistry. The lecturer should be a man who did not receive any portion of his training in a pharmacy or medical school, as this kind of training tends to cause the lecturer to make pharmaceutical applications in order to arouse interest in the student and neglects his principal mission of creating a vision of chemistry and giving the student a thorough drilling in the general principles underlying the science. On the other hand, experience has shown that it is not objectionable for the laboratory director to have chemical training above that which is necessary to become a pharmacist and, as a matter of fact, this is very often desirable. The additional training aids the instructor to connect the general principle with the specific case and will, if properly correlated, impress indelibly in the mind of the student that the lecture and laboratory courses are inseparable and both have the same aim, *i. e.*, the chemical education of the student.

The content and purpose of the laboratory and lecture courses make it necessary for both men to coöperate to the last detail in order to properly cover the required curriculum. To illustrate, after the lecturer has expounded and elaborated the valence and oxides of phosphorus and shown its numerous commercial applications, the laboratory man preceding the laboratory experiments will discuss very fully the pharmaceutical applications of the acids of phosphorus, the importance and reactions of the alkali phosphates and just why the student of pharmacy should center his time and attention at this point. After the discussion of the position of arsenic in the periodic table and the general chemistry surrounding this important element by the lecturer, the laboratory director will point out just why certain pharmaceutical preparations require alkali bicarbonate to dissolve arsenous oxide and why in other cases hydrochloric acid is used to effect the same. The director of the laboratory will have the student carry out the arsenic test as recognized by the United States Pharmacopœia instead of following some general text. After the mastering of systematic qualitative analysis scheme the student is given unknown specimens which are of a pharmaceutical nature yet illustrate and point out the use of the qualitative scheme. In many cases the Pharmacopœia demands the absence of or limits the amount to be present of certain impurities in drugs; here again the laboratory director uses this opportunity to connect qualitative analysis with the every-day operation of the pharmacist. Thus the detection of the presence of lead and sulphuric acid in citric acid is very interesting and instructive to the student, as the purity of the product he sells means the reputation he will establish in his community.

In the second year's instruction after the lecturer has given the student an intelligent conception of the alcohols, the director of the laboratory then carries out his part of the program by pointing out the importance of alcohols to pharmacy, the impurities likely to be found present and the Pharmacopœial tests for purity. In organic chemistry the laboratory man must devote more time to lecturing than in inorganic chemistry and should follow up each class of organic compound with lectures on pharmaceutical products that occur in that particular class. Thus under the sulphur derivatives of the ketones the pharmacist has a list of hypnotics—trional, sulphonal, etc.—the structure of which and method of preparation are extremely important to pharmacy students. Instead of having the student extract caffeine from tea or coffee as is usually done in general chemistry courses, the pharmacist substitutes Guarana, the crushed seeds of a Brazilian plant, which is used as a stimulant and nervine in medicine and contains 4% of caffeine.

Quantitative chemistry presents a very striking example of this method of teaching the science. The lecturer may or may not deal with the theory of quantitative chemistry; in the author's experience it has been found advantageous to allow the laboratory director to handle the subject of quantitative chemistry after the lecturer has given the student the general chemist's point of view on the subject. In this course, the Pharmacopœia in its many assay processes offers an example for practically each type of analysis made in an elementary course. The halogens are estimated by the Pharmacopœial method, aluminum as oxide from the official alum iron by the dichromate and permanganate processes in pharmaceuticals, morphine from opium and many other applied, yet comprehensive experiments.

The chemistry of the advanced courses are of course taught with the aim of making the student proficient in the particular branch he has chosen. In the third and fourth years physical and physiological chemistry are taught in addition to advanced qualitative and quantitative work with food and drugs.

This plan of presenting chemistry to pharmacy students has in its entirety proved practicable and successful in the Pharmacy School of the University of Maryland and will, if conducted properly, accomplish a two-fold purpose: First, to give the student as broad an aspect as possible of the science of chemistry and, second, to give a course in chemistry that is useful and applicable to pharmacy.

Delegates to the International Pharmaceutical Federation—London, England.

Sitting—front (from left to right)—Dr. J. J. Hofman (Secretary), C. L. Butchers (Australia), Prof. Van Itallie. (President), J. Loisel (France), A. Van Den Dries (Holland).

Second Row—A. Langrand (France), D. H. Lacroix (France), Cav. F. Pratta (Italy), M. Pattou (Belgium), Dr. A. Schamelhout (Belgium), W. A. Carter-Ross, W. A. Carter (Shanghai), E. Collard (France).

Third Row—V. Van Itallie (Holland), Mr. W. B. Falding (London), Dr. Angel Morales (Spain), Dr. A. Bouville (France).

Back Row—Sir Wm. Glyn-Jones, Mr. V. Cofman, Cav. Dr. A. Robaldo (Italy), Mr. Ed. White, M. Rousseau (France).