THE DEPARTMENT OF THE AMERICAN ASSOCIATION OF COLLEGES OF PHARMACY

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PREREQUISITES TO PHARMACEUTICAL CHEMISTRY.

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At the last meeting of the American Association of Colleges of Pharmacy, the Conference of Teachers of Chemistry devoted their attention to the subject of Pharmaceutical Chemistry and a series of papers was presented on this important subject. These papers will be printed in this Section consecutively, and the teachers of chemistry in member-colleges are requested to give them their careful attention. Discussion and comment are invited.—C. B. JORDAN, *Editor.*

Few subjects are discussed more frequently by educational bodies than what should be the prerequisites for the various courses of study in the curriculum. Such a theme is popular because it affords ample opportunity for an individual to express not only his views and opinions but to present what he considers the proof that he is right. For example, excellent and persuasive papers have been prepared to show that physics should be a prerequisite to chemistry; while equally as forceful and convincing discourses have been delivered in the support of chemistry as a prerequisite to physics. It is indeed interesting to hear the proponents of each side give many practical cases as proof of the correctness of their respective and opposing assertions.

It is not surprising, therefore, that educators have not yet agreed what phase of chemistry should precede another. One prominent American chemist insists on his students studying quantitative analysis before qualitative, his main argument being that simpler chemistry and less discrimination are required for quantitative analysis than qualitative. Another chemist has for several years introduced his students to organic chemistry before inorganic and declares that the results are highly gratifying. Some colleges require physical chemistry before qualitative analysis, quantitative and organic; while others require the last three as prerequisites to physical chemistry, and some do not require physical chemistry at all for students majoring in chemistry. Finally there are educators who argue that the division in which scholastics have divided chemistry is purely arbitrary and has no basis in nature and results in the narrowing rather than in the broadening of the student's knowledge of the science of chemistry.

A cloudy day in chemistry is our first thought; but not so, for behind the clouds is the sun still shining, so let us "turn the clouds wrong side out just to show the silver lining," which is equally as bright and attractive as that presented by other subjects. For example, some study Shakespeare in high school; others register for the same plays as seniors in college; still others pursue them as a graduate course; while another person uses them as the basis for his dissertation for the doctorate. What then shall be the prerequisite for the study of Shakespeare? It all depends upon the wherefore and therefore of the instruction. The teacher in the high school has a motive different from that of the college professor.

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Both lead their flocks into the same green pastures and beside the same still waters; but the visions are different.

The various branches of chemistry afford an analogy. The simple principles of chemistry as taught in the secondary schools are usually presented in general chemistry in order to afford the beginner an elementary survey of the field of chemistry and not because the fundamentals of general chemistry are simpler than the elements of any other particular branch of chemistry. When inorganic chemistry is the first course pursued by a student it differs greatly from a graduate course in inorganic chemistry. I suppose any branch of chemistry might be profitably taught first, if the professor adapted his method of instruction to the drawing out properly of the mind of the student. However, when the professor has once decided on what his first course shall present, his second course should be arranged to follow with the understanding that the student has fairly well mastered the first course. Thus a professor begins to establish a prerequisite. His prerequisites, therefore, though they differ from those of others, may be just as sound educationally and of the same practical success.

The idea of prerequisites in chemistry is largely due to the order in which we ourselves studied the different branches of the subject—a kind of educational inheritance which we have converted into an environment and zealously guard. I have in mind a professor of chemistry, now growing old in experience and reputation, who first studied physical chemistry as a graduate subject and to this day he believes it belongs in the graduate school. Also, I am not unacquainted with other chemists who studied physical chemistry early in their college course and who now insist that the subject be presented in the sophomore year. Though we may not all be able to agree as to prerequisites, there has come about through years of practice a kind of resultant of all of our various opinions. This resultant actually exists and it will be used as our line of thought. A study of a large number of catalogs of the member-colleges will show this resultant either boldly outlined or shadowy.

Therefore, our specific subject for to-day, "Prerequisites to Pharmaceutical Chemistry," is justifiable and a discussion should prove profitable to us, even though we reach a compromise instead of an agreement. The formulation of an order of sequence based upon the common practice which has proved successful will also be beneficial to students who transfer from one college to another. For instance, should one of our member-colleges designate two years of chemistry as a prerequisite to its first course in pharmaceutical chemistry and should another one require no chemistry, it is evident that the content of the two courses is different and cannot be accepted as the same.

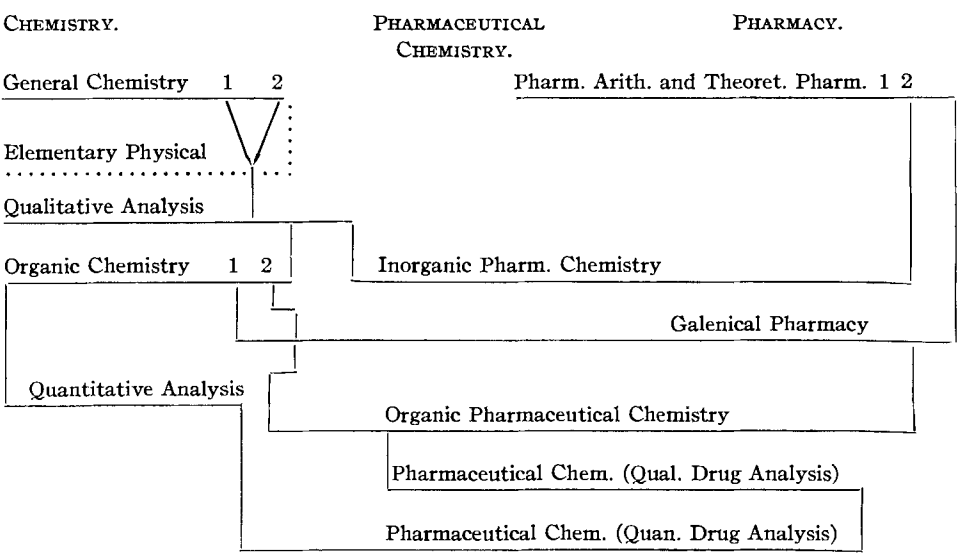
Before proceeding further it will be advantageous to define the term, pharmaceutical chemistry, as it will be used in this presentation. By pharmaceutical chemistry we do not mean to include every branch of chemistry taught to pharmacy students. The course takes its name from its content and not from the class that studies it. While in inorganic and organic chemistry some of the pharmaceutical uses of many compounds may be given, we do not consider these subjects as pharmaceutical chemistry any more than we would call general chemistry physical chemistry because we, necessarily, present some of the physical laws of matter and physical characteristics of the elements and compounds studied in

that course. By pharmaceutical chemistry, then, we mean that branch of chemistry which treats more specifically of natural and synthetic organic and inorganic substances employed in the science and art of pharmacy.

In this discussion we shall consider only those courses in chemistry and pharmacy which should be prerequisites to the different divisions of pharmaceutical chemistry, such as inorganic pharmaceutical chemistry (sometimes cataloged as inorganic pharmacy), organic pharmaceutical chemistry, qualitative drug analysis and quantitative drug analysis. Since pharmaceutical chemistry itself presents so many different phases of chemistry and pharmacy and since the effective teaching of the different phases depends upon the student's previous training, it is evident that the prerequisites will increase in number as he progresses in the study of pharmaceutical chemistry.

Before deciding upon the sequence of the courses and their respective prerequisites the instructors of chemistry and pharmacy of the particular college should have a thorough understanding of the contents of the various courses to be offered. For example, if a special course in elementary physical chemistry is required in the sophomore year before qualitative analysis, the instructor of the latter subject should arrange a course different from a course in qualitative analysis for the student who has had no physical chemistry. If no organized course in physical chemistry occurs in the curriculum, this subject must be presented along with general, qualitative analysis, quantitative analysis, and organic chemistry and every professor concerned must be aware of what is expected of him so that on the completion of all the courses the student has not missed the fundamental principles of physical chemistry. For the purpose of illustration, the disposition of physical chemistry in the scheme of prerequisites for pharmaceutical chemistry is shown by placing it on a dotted line in the diagram which follows:

DIAGRAM OF THE PREREQUISITES TO PHARMACEUTICAL CHEMISTRY.



We first require a course in general chemistry in which the fundamental principles are studied, the subject being taught by lectures, illustrated with ex-

periments, recitations, reading assignments, individual laboratory work, quizzes, motion pictures, lantern slides, charts, etc. Among the topics presented are those in general as outlined by Dr. E. V. Lynn in the "Tentative Pharmaceutical Syllabus, Fourth Edition," who admirably sets forth the aim of such a course. This course requires about three lectures or recitations per week and six hours of laboratory work including quizzes per week throughout the year. In some colleges it may be found advantageous to devote the laboratory work of the second semester to qualitative analysis, supported, of course, by lectures and recitations in that subject. This option is illustrated in the diagram by the suspension of qualitative analysis upon a Y, one limb of which is attached to the first semester, the other to the second semester of general chemistry signifying a choice of prerequisites. The choice, of course, largely determines the method of presentation. However, it is generally best to follow a year of general chemistry by a course in qualitative analysis such as outlined by Dean C. B. Jordan (*Ibid.*), concerning which he says,

"It is assumed that the student has completed a study of the metals and non-metals. A study of the metals may accompany qualitative analysis, if it has not preceded it. At any rate a review of all of the reactions of metals and non-metals that form a basis for the separation and identification of them should be given."

While the student is pursuing general chemistry and qualitative analysis he is also studying pharmaceutical arithmetic and theoretical pharmacy, a semester each. The pharmaceutical arithmetic includes the application of mathematics to pharmacy, a thorough study of the system of weights and measurements and their relation to each other, and laboratory work which acquaints the student with the weights and measures studied, and experiments are carried out on specific gravity, percentage solutions, thermometry, etc. Theoretical pharmacy includes the history and nomenclature of the U. S. P., the N. F. and a study of the apparatus and practice of the processes of operative pharmacy. The student conducts in the laboratory operations illustrating the principles considered in the lecture and performs the simpler pharmaceutical operations.

The course of qualitative analysis is followed by organic chemistry, and this, in turn, by quantitative analysis, if they are not taken simultaneously. The scope of the course in quantitative analysis as outlined by Dean Jordan (*Ibid.*) is, in our opinion, highly satisfactory; as is likewise the course in organic chemistry as outlined by Dr. Lynn (*Ibid.*).

While the student is pursuing the first semester of organic chemistry he is also taking inorganic pharmaceutical chemistry (sometimes cataloged as inorganic pharmacy), having as prerequisites qualitative analysis and theoretical pharmacy and involving a consideration of inorganic compounds used in medicine, their origin; their physical, chemical and physiological properties; and the preparation of those inorganic substances and their use in compounding remedies.

After a student has had the first semester of organic chemistry he is ready for galenical pharmacy, which has theoretical pharmacy as an additional prerequisite and involves such preparations as syrups, spirits, tinctures, extracts, emulsions, etc., and their manufacture in larger amounts by the use of pharmaceutical machinery. Next comes organic pharmaceutical chemistry, which includes the preparation, properties and uses of natural and synthetic organic drugs, having two semesters of organic chemistry and galenical pharmacy as prerequisites.

The outline as given by Dr. Glenn L. Jenkins (*Ibid.*) is worthy of close study and application in general.

Then follows qualitative drug analysis for a semester, this course being the detection of the common synthetics, glucosides and alkaloids in pharmaceutical preparations. The tests used are those commonly accepted as evidence in medico-legal cases. The laboratory work is on powders, solutions, emulsions, etc. After organic chemistry, quantitative chemical analysis and qualitative drug analysis, as illustrated in the diagram, comes quantitative drug analysis which may be briefly defined as the quantitative analysis of pharmaceutical materials by physical means, or by chemical methods, gravimetrically or volumetrically. After reaching this point, a further discussion of the subject would doubtless be so theoretical that it would be of no practical value.

A HOSPITAL DISPENSARY.

"Great changes have occurred in the quantity and character of the drugs used during the last 130 years. It is worth while looking at two or three of the chief items used in the hospital dispensary 100 years ago. Sulphate of magnesia came into common use about the beginning of the nineteenth century, and replaced the purgative waters of the neighborhood of London, notably Streatham and Islington, which were so freely used in the previous century. In 1836 the consumption of magnesium sulphate at St. Bartholomew's Hospital was 26 cwt. a year, and in 1876 it had risen to 43 cwt. The consumption of linseed meal for poultices, the use of which began some 150 years ago, was over eight tons in 1836, and by 1885 had reached the enormous amount of 15¾ tons. The use of linseed meal slowly declined after the introduction of antiseptics by Lister, and has now almost completely disappeared. From reading contemporary novels we are familiar with the fact that blood-letting was prevalent and fashionable in the early part of last century, but it is almost impossible to believe that in the year 1837, the year Queen Victoria began to reign, we used in the hospital 96,300 leeches. When we consider that leeches were but one way of letting blood, and that we had consulting cuppers and assistant cuppers, we may well believe that our grandfathers were a full-blooded race.

"Apothecaries remained on the staff of St. Bartholomew's Hospital from 1567 to 1867—that is, for 300 years. It is quite clear that at some period of the time they were responsible not only for the drugs but also for the treatment of patients. Thus, in 1757, it was noted that the apothecary was seeing about 250 out-patients a day, while the physicians and surgeons were attending to the in-patients; and also in 1840 there was an assistant apothecary, part of whose duty was to cup in-patients. The office of apothecary to the hospital was finally abolished in 1867, when in his place four house physicians were appointed. Up to that time, Mr. Wood, who was the last apothecary, performed the duties in the out-patient department which are now performed by some twenty-five resident officers. It is handed down by tradition that Mr. Wood was exceedingly clever in rapid and facial diagnosis, and that he never overlooked a serious case which required urgent operation. It has been told me by some who knew him that the method of work was as follows. He stood on a chair in the casualty department with a number of tickets for medicine in his hand, and he called in a loud voice—'All those who have a cough, stand up,' and these received tickets for cough medicine. He would then call—'All those who have stomach-ache, stand up,' and they would receive likewise a ticket for the appropriate medicine, and so on until he had emptied the surgery."—Prof. G. E. Gask in *Pharmaceutical Journal and Pharmacist.*

Merry Christmas and a Happy and Prosperous New Year!
