For many years the colleges of pharmacy have begun the teaching of pharmacy in the freshman year. This was due to our short course, making it necessary to introduce pharmacy as soon as the student entered the college. The question has been debated many times as to whether it would not be better for the student to have had a year of chemistry and physics before being introduced to the subject of pharmacy. When our four-year courses become operative, such a procedure will be possible. At present, however, it would seem necessary to introduce pharmacy in the freshman year. The following paper by Professor Shkolnik treats of the application of chemistry to pharmacy and is worthy of careful consideration by all teachers of pharmacy.—C. B. JORDAN, *Editor*.

SHOULD CHEMICAL REACTIONS BE STRESSED IN TEACHING PHARMACY?

BY SAMUEL SHKOLNIK.*

We are all aware of the fact that the nature of the various courses taught in a College of Pharmacy is such that they do overlap one another, and that no sharp line of demarcation can be drawn between them. Quite frequently, therefore, it becomes necessary to discuss chemical reactions in connection with the subject of Pharmacy as such, particularly in the Pharmacy Laboratory, if we desire students to understand what they are doing. I shall confine myself in this article to the discussion of the "propriety of stressing chemical reactions in the Pharmaceutical Laboratory rather than leaving it entirely to the Chemistry Department wherein the subject of Chemistry is studied as such."

Let us picture outselves in a Pharmacy Laboratory giving instruction to a group of students on the preparation of the popular solution—"Lime Water." If it be contended that chemical reactions are not to be stressed in this laboratory, what would be the nature of the instruction? Undoubtedly the method as outlined in the U. S. P. would be presented, the materials necessary for its manufacture distributed, and the instructor with his grade book and pencil in his hand would pass back and forth through the aisles of the laboratory to see that the solution is properly put up and that all rules of technique are observed. Most of us know that this method would be very unsatisfactory, for the students, though given detailed information in the U. S. P. regarding the manufacture of this preparation, and its storage, will not, or cannot, or both, correlate the various points for themselves and cannot, intelligently discuss either its composition, nature or method of storage.

I have tried it and have had that very experience. They weigh out the directed ingredients and follow the directed procedure without knowing what they are doing or why they are doing it, notwithstanding that they have covered in the Chemistry Department the study of the alkaline earth metals and their compounds. Now, why? Because, while reading the directions from the U. S. P. the average student sees before him only nothing more than a group of words; he does not seem to be able to use his knowledge of elementary chemistry (and that is all the chemistry involved here) which, as I said before, at the time of the manufacturing of this preparation he has already had, or at least has been exposed to. A question like this—"Why was the Official Latin title of this solution changed from Liquor Calcis to that of Liquor Calcii Hydroxidi"—is almost unanimously proclaimed by

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them as a *sticker* or *catch question*, or the like—they are not jealous of phraseology. To put it very mildly is to say that we are crediting them with too much intelligence when we expect them to use their chemistry knowledge and be able to apply it to pharmaceutical operations without further pointing out to them the chemical reactions involved in such operations at the time they take place.

Now let us picture ourselves in the same laboratory with the same group of students about to manufacture the same preparation. At this time let us have the instructor point out and stress the chemical reactions involved and write the equations representing same. The students are not given to understand that the reason why they are directed to slake the lime with a little warm distilled water is, not because the U. S. P. says so, but because warm distilled water facilitates the conversion of calcium oxide (Lime) to calcium hydroxide as represented by the following equation—$CaO + H_2O = Ca(OH)_2$—which is the compound in the finished product. This explanation helps them retain the fact that the finished product is nothing more than calcium hydroxide dissolved in water and then the question regarding the change in title, referred to above, ceases to be unanswerable. Let us also tell them, that the preparation should be stored in "well-filled, tightly-stoppered bottles," again, not because the U. S. P. says so, but because carbon dioxide is a constituent of the air and the stratum of air immediately above the solution, in a partially filled or unstoppered bottle, brings sufficient carbon dioxide in contact with the solution to convert, at least some of the calcium hydroxide, to calcium carbonate which, being insoluble, precipitates out, as represented by the following equation—$Ca(OH)_2 + CO_2 = CaCO_3 + H_2O$—thus decreasing the strength of the preparation. This information in turn enables the students to understand why the solution turns cloudy on standing and what effect such turbidity has on the strength of the preparation.

Referring to its use in the manufacture of Linimentum Calcis, let the students be told at this time about its function in the latter preparation—that its alkalinity tends to saponify, partially at least, the linseed oil used therein and change it into a calcium soap. If, therefore, the lime water turns turbid on standing it should not be used in the manufacture of Linimentum Calcis, for the turbidity indicates that some of the calcium hydroxide, if not all, was precipitated as calcium carbonate and its alkalinity correspondingly decreased or completely removed.

It is true that this method of instruction means repetition of what they have already had in the Chemistry Department, but I found in my experience that, as far as making students get and retain information is concerned, nothing can take the place of repetition. This repetition has a double effect. It not only gives them an intelligent understanding about the Pharmaceutical Preparations that they are manufacturing but it also tends to crystallize in their minds many principles of General Chemistry. For example, they have learned in general chemistry that calcium is a metal and that oxides of metals form bases when in contact with water. They have also learned that carbon dioxide bubbled into Lime Water produces calcium carbonate, a precipitate, and that an excess of carbon dioxide redissolves the precipitate by forming calcium bicarbonate which is soluble. In fact they have carried out such experiments in the Chemistry Laboratory and yet, when the same principles are now presented to them in the Pharmacy Laboratory, they do not seem to be able to put two and two together. When they studied this subject matter in the Department of Chemistry, the term "Lime Water" did not mean to them a definite pharmaceutical preparation, but only another one of the many "stuffs" used in testing. Their study there was more of an abstract nature and as such was not lasting; there was nothing concrete for them to retain.

I have used lime water in this discussion because it involves very simple chemical reactions and yet affords a good example of the need for stressing chemical reactions in the Pharmacy Laboratory. Of course, numerous other examples could be cited in which the chemical reactions are more complicated, but these cases would only serve to emphasize the reason for stressing chemical reactions in Pharmacy. I shall, therefore, not practice what I preach, for I do not wish to bore you with repetition.

CONCLUSION.

During the past five years as a teacher in the Pharmacy Laboratory at the University of Illinois School of Pharmacy I have tried both methods of presenting the work and have come to the conclusion that chemical reactions must be stressed in the Pharmacy Laboratory. I have found that by so doing the students can thoroughly understand and explain what chemical reactions take place in the manufacture of the preparations they make, what the composition and nature of the finished product is and in what manner it should be preserved. This makes the exercise more interesting for them and creates in them a confidence in their ability to manufacture preparations and do it properly. Aside from the fact that a thorough knowledge of this kind is symbolic of an educated pharmacist and distinguishes him from the many so-called pharmacists, what, may I ask, is more essential to intelligently practice Pharmacy than a knowledge of the nature and composition of the products to be used? According to my observations, and I think you will agree with me, that stressing chemical reactions in the Pharmacy Laboratory contributes materially toward such knowledge.

MEDICAL AND PHARMACEUTICAL STUDIES IN CHINA.

The Dojinkai has recently decided to establish the following enterprises in China:

1. Health administrative organ: Establishment of a central health department and a local health bureau, the organization of medical corps in all garrisoning armies, and the establishment of the army and navy quarantine.
2. Medical and pharmaceutical educational institutions, relating to medical and pharmaceutical colleges in all provinces.
3. Medical treatment organ: Organization of hospitals and their personnel.
4. Medical bodies: Physicians' organizations both native and foreign, and other phases.
5. Regarding the Dispensaries: Their conditions, business and associations and their rules, with a geographical distribution of prepared medicines.
6. Medical materials, cultivation of poppies, the demand and supply of opium; ginseng, camphor and other materials.
7. Regarding diseases: small-pox vaccination, demand for serum, statistics on regional diseases, treatment of insane.
8. Other status on medicine and health.

Prepare for Pharmacy Week—October 12th—19th.