seems to your speaker to be often a stranger to the student of pure research if the remarks and criticisms one hears so constantly are any criterion.

Finally the student acquires from day to day the conviction that by diligent application to *all* his university work he is preparing himself for the grave responsibility which the acceptance of industrial service involves.

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THE USE OF THE BLUE PRINT IN THE TEACHING OF INDUSTRIAL CHEMISTRY.

BY FRANCIS C. FRARY.

In the teaching of industrial chemistry and similar subjects the problem of familiarizing the student with the machinery used in the chemical industries is one which must always be met. If we had an ideal textbook for such a subject, with a large number of clear, accurate illustrations, well described and showing the parts drawn to scale, the problem would be much simplified. But that is perhaps too much to ask, since the cost of such a work would be large and the number of copies sold per year would be small. Frequent revision would be necessary, and there would be nothing in it for the author. Since we have no such book, and no prospects of it for several years, we must meet the needs of the student in some other way.

The simplest and easiest way of doing this, from the instructor's point of view, is to refer the student to some book or journal in the library which gives the desired information. But most of the students will have so much else to do that they will scarcely glance at the article, if indeed they go so far as to look it up at all. Another method, very widely used, is for the instructor to sketch upon the blackboard, from his notes, the important parts of the machine under consideration, and give the student time to copy the sketch. The original drawing which the instructor selected to illustrate the apparatus may have been very fine, but it would usually be hard to identify it as the source of the sketch in the student's note-book. Much valuable time is thus wasted in giving the student a very inadequate idea of what he should know. And in most cases, after the sketch has reposed in his note-book for a year, he could not tell what it was all about.

Perhaps the chart method may be mentioned as the next step in advance. Here, at least, we have finished originals, full of detail, often in realistic colors and of large size, and the student may copy them to better advantage. But the lecturer has nothing else to do while the student is copying the chart, so he usually takes that time to explain to the class the details of construction and operation of the apparatus. If the student takes time to copy the drawing, he misses the explanation, and *vice versa*. And even if he does his best at the copying, the result is still likely to fail

to show many important details, and to be out of proportion and misleading. Then too the original charts are expensive, and most of those for sale by supply houses are either far behind the times, or else show foreign practice, which may be entirely different from that of the American industry. On account of the cost of the charts, too, a set once purchased will probably be used as long as it keeps up a respectable appearance, and the antiquated machinery becomes yearly more so as it is inflicted upon successive classes.

Lantern slides which may also be purchased or made to order have similar drawbacks, with the additional one that the student must copy them in a poor light, and the instructor seldom thinks it is worth while to show only one or two slides, when they are all that bear on the day's lesson.

The idea of giving each student blue prints of the apparatus under consideration, and having him paste them in his note-book, appears to have originated, as far as I can ascertain, with Dean W. R. Appleby, of the Minnesota School of Mines, who has used this method in the classes in metallurgy for some time. Knowing from personal experience in such classes how valuable the system is from the student's point of view, the author has applied it for several years to the teaching of industrial chemistry and electrochemistry, and believes it to be well worth the attention of others interested in the same line of work. From articles published in various scientific journals, from the advertisements in some of them, from patent specifications and the catalogs of manufacturers it is easy to get drawings, sections and photographs of almost everything desired. The negatives once made from these, the instructor can have the janitor or the laboratory boy make as many prints as desired for the use of the class. If advantage be taken of the summer sun, the printing process is very rapid, especially if the negatives be made upon wet-plates. The paper costs only about five cents per square yard, and the prints, neatly stored away in envelopes, are always ready for distribution.

In this way no time is lost in the attempt of the student to draw something which he has never seen, and he has an accurate picture, in proper proportions, which shows the important or peculiar parts of the apparatus. All sketches are alike, and, if desired, where the parts are lettered, the descriptive matter or list of parts may be included in the blue print so that the student may study out the construction and operation of the machine at his leisure. The student, having a good original in his note-book, can be held responsible for a fair knowledge of the machine and be required to make a sketch of it later in a quiz, and he has something in his notes to which he can refer at any time with certainty. When enough prints are to be distributed to make it worth while, a lantern slide corresponding to the blue print is a great help, as the details can be

more readily pointed out to the student, while he still has the copy to put in his book.

Although satisfactory results may be obtained by the use of process plates, or even of any slow plate in the making of the negatives required, still where many plates are to be made at the same time, the quality of the results and the speed of manipulation place the wet-plate in a class by itself. Not only are the resulting prints more contrasty, and thus more like the black and white originals, but the negatives will print in a fraction of the time otherwise required, and far less care is needed to get a good print. In reproducing a line drawing, an over-exposure of 100 per cent. does not materially injure the print from a wet-plate negative. With rapid paper, printing takes about a minute, and three or four frames will keep a man busy.

By using blue prints it is easy to keep up with the times and add new things as they appear, without much labor or delay, and this method would seem to have advantages over all others for teaching the construction and operation of industrial machinery.

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THE ACQUIREMENT OF PROFICIENCY IN QUALITATIVE ANALYSIS.

A DIGEST OF PRESENT AMERICAN IDEAS.

BY HERMON C. COOPER.

The scope of a thorough course in qualitative analysis seems to be such an unsettled matter that I have sought to ascertain by correspondence the current American opinions regarding it. The majority of those asked have replied, and all the replies (twenty in number) have shown great interest but no unanimity of opinion.

Notwithstanding that a large amount of thought has been given to the analytical methods of qualitative analysis rather little attention seems to have been paid to the scope and ultimate value of the course. The problem of a thorough course is one of pedagogical concern rather to universities that develop professional chemists than to the independent colleges and other schools that afford liberal education. Moreover it is a different problem in America from what it is in Germany, where qualitative analysis is the main feature of the introductory practicum.

A thorough course will be generally regarded as including practice in the reaction tests and systematic methods of separation of about twenty-five metals, the same for at least thirty acids, a brief study of selected preliminary dry tests and a presentation of a systematic procedure of "dissolving," *i. e.*, preparing materials for analysis in the wet way. The instructor easily follows the beaten path through the complete analysis of simple salt mixtures and his class is consequently introduced to the