a drug store on the steamship Leviathan may feel that if anybody is free from competition, he is so situated. Yet he has a golden opportunity to create good will and, indeed to increase his sales, if he asks no more than the usual, or so-called, full prices for the standard merchandise which he sells. On the other hand, no one would argue that a druggist so situated should carry this desire to create good will and sales to the point of selling his merchandise at prices comparable with those of the most aggressive price cutter in New York City.

Even in cities in which price cutting is particularly aggressive—Kansas City and Chicago are examples—druggists who do not aim to attract business on a price basis have found that they can maintain their usual volume of sales without dropping their prices on standard merchandise to the lowest levels reached by aggressive price cutters in those cities.

However, it is usually necessary for them to make some concessions in prices on standard, identified merchandise in order to avoid creating the impression that prices of all merchandise sold in these stores are inordinately high.

It is a fact, proved by detailed cost examinations by the Druggists' Research Bureau that, when necessary or desirable, prices on popular standard merchandise can be dropped to a level which is no less than 6 cents above the net cost of some such merchandise and still be profitable. Below this level, it is doubtful if popular, identified merchandise can be sold at any profit in a drug store, regardless of the amount sold or the rate of turnover. A gross margin of 6 cents above the net cost of popular, standard merchandise is believed to be, therefore, the lowest price to which such merchandise can be cut and its sales still produce some profit.

All of this discussion of cut prices and their effects on drug store profits must force once again the conclusion that drug stores which depend for most of their success upon the professional services which they render are far free from the frequently disastrous effects of cut prices than drug stores which make the bulk of their sales in popular identified merchandise. Thus is shown for the great majority of drug stores the economic, as well as the ethical importance of the professional side of pharmacy.

PHARMACEUTICAL ENGINEERING.*

BY ARTHUR F. PETERSON AND ROBERT J. RUTH.

During the last few years pharmacy has been passing through a transition from the combined prescription and commercial pharmacy to the ethical prescription pharmacy on the one hand and to the purely commercial drug or patent medicine store on the other. Colleges of pharmacy have lengthened their courses in pharmacy to meet the needs and demands of the modern prescription laboratory, to make the individual a better and more exacting pharmacist and to broaden his power of usefulness to the physician as bacteriologist or physiological chemist, and further to give him a broader cultural background.

While progressive changes have been taking place in retail pharmacy even greater progress has been made in the manufacturing pharmaceutical, biological and medicinal chemical field. Better trained individuals in greater number are

* Section on Education and Legislation, A. PH. A., Miami meeting, 1931.

required now than before. It is unfortunate that it seems that these better trained workers are not being supplied from the pharmacy colleges as much as from colleges of chemistry, medical schools or agricultural colleges. This progress in the various pharmaceutical branches has necessitated the designing of new equipment, machinery and plants. It has made use not only of a greater knowledge of chemistry, physics and biology but also of a considerable knowledge of engineering as well.

The combining of courses in pharmacy with courses in engineering in our opinion offers one of the most promising of futures for the young man or woman who is really scientifically inclined. There is need for good courses in what we prefer to call Pharmaceutical Engineering. So far as we are aware, there is not now offered anywhere a course in Pharmaceutical Engineering. Would it not seem more logical for a pharmaceutical manufacturer to employ a Pharmaceutical Engineer than a chemical engineer? The latter is not primarily pharmaceutically minded. A well-trained Pharmaceutical Engineer, as we look upon his college preparation, which we shall outline below, will have as good a foundation in chemistry and engineering as the chemical engineer and will, in addition, know pharmacy, acquired from the ground up, so to speak. By pharmacy we refer to scientific pharmacy.

Some of our readers may wonder how large a field there is for the Pharmaceutical Engineer. The Pharmaceutical Engineer would find prospective employment wherever there is need for chemical or pharmaceutical and engineering knowledge. Let us enumerate some products the manufacturers of which employ chemical or pharmaceutical and engineering knowledge, and where pharmaceutical engineers would be expected to find not only desirable employment but that of the variety requiring highly technical knowledge:

1. Pharmaceuticals
2. Chemicals
3. Biological products
4. Acids
5. Alums and other aluminum products
6. Ammunitions and related products
7. Cleansing and polishing preparations
8. Compressed and liquefied gases
9. Proprietary medicine manufacture
10. Explosives
11. Fertilizers
12. Glue and gelatin
13. Linseed oil, cake and meal
14. Miscellaneous chemicals
15. Nitrogen and fixed nitrogen compounds
16. Paints and varnishes
17. Perfumes, cosmetics and other toilet preparations
18. Salt mining and refining
19. Soap
20. Dyestuffs, mordants
21. Wood distillation
22. Petroleum manufacture
23. Rubber products
24. Corn products
25. And probably many more.

The dollar value of output in the drug industries is increasing constantly. In 1921 the output for the U. S. was approximately $330,000,000; in 1927 it had increased to approximately $548,000,000. In 1927 there were in the U. S. about 2360 establishments manufacturing druggists' preparations. These plants employed, roughly, 55,200 persons, an average of 24 persons per establishment.[1] In the same year there were 457 plants manufacturing chemicals exclusive of those manufacturing (1) sulphuric, nitric and mixed acids, (2) explosives, (3) fertilizers,

[1] Dept. of Commerce Bulletin: Census of Manufactures. The Drug Industries: 1927.

and (4) wood distillation products. There were 35 establishments manufacturing sulphuric, nitric and mixed acids.[1]

The following figures are available for 1929:[2]

Industry.	No of establishments.	Wage earners, aver. for the year.	Value of products.
Ammunition and related products	20	7,217	23,960,105
Canning and preserving	3203	110,002	815,564,812
Chemicals, not classified elsewhere	532	62,130	725,600,389
Cleaning and polishing preparations	380	2,456	42,778,000
Compressed and liquefied gases	356	3,273	51,493,571
Druggists' preparations	418	10,739	126,647,771
Drug grinding	25	608	9,633,159
Explosives	97	5,775	74,535,916
Fertilizers	592	19,690	219,001,224
Fireworks	46	1,791	6,572,542
Flavoring extracts and flavoring syrups	567	4,685	117,395,640
Glue and gelatin	74	2,993	32,458,019
Iron and steel; blast furnaces	103	26,296	773,098,818
Mucilage, paste and other adhesives except glue and rubber cement	91	495	7,953,762
Paints and varnishes	1036	28,894	563,031,490
Patent and proprietary medicines and compounds	1481	16,281	313,764,874
Perfumes, cosmetics and other toilet preparations	803	12,960	191,039,469
Petroleum refining	375	76,840	2,611,680,940
Rayon and allied products	28	38,938	149,276,487
Soap	274	14,050	303,377,358
Sugar refining, cane	21	13,920	507,389,262
Tanning materials, natural dyestuffs, mordants and assistants, and sizes	111	2,204	34,374,239
Wood distillation and charcoal manufacture	91	4,642	29,617,290

When one considers the thousands of plants into which the Pharmaceutical Engineer would fit, it does not require a very wide stretch of the imagination to determine that it will be a long time to come before the chemical and pharmaceutical industries would not absorb all the pharmaceutical engineers that the universities may graduate.

Other things being equal, the Pharmaceutical Engineer would be given preference of position and advancement over all others particularly in Pharmaceutical and Medicinal Chemical establishments. Positions, among others, for which Pharmaceutical Engineers would be given preference may be mentioned: (1) General Superintendent, (2) Departmental Superintendent or Manager, (3) Chief Chemist, (4) Chief Control Chemist, (5) Chief Research Chemist, (6) Production Manager, (7) Employment Manager, (8) Purchasing Agent, (9) Cost Accountant, (10) or any other executive position connected with the plant, its operation or control. In the planning of a new plant and its equipment, and in its construction and installation of equipment, the pharmaceutical engineer would have the major rôle.

At this point it might be interesting to relate a true story told to one of the authors by a dean of a north central states college of pharmacy during his recent visit to Minneapolis. During our conversation he was asked what he would think

[1] Dept. of Commerce Bulletin. Chemicals: 1927.

[2] Dept. of Commerce Bulletin: Census of Manufactures: 1929. Summary of Industries.

of a course combining pharmacy with engineering. Discussion followed. He seemed favorably impressed with the idea. He said that a few years ago a man having an Engineer's degree decided to study pharmacy and subsequently enrolled in this Dean's college. When the engineer had completed the course in pharmacy, for which he received the degree of Pharmaceutical Chemist, he obtained a position with one of the larger pharmaceutical houses. The salary was said to have been $3000.00 per year. After a period of three years, this Engineer-Pharmaceutical Chemist was sent to a foreign country to supervise the construction of a branch pharmaceutical plant and its subsequent operation at a salary said to have been in round numbers $8000.00 per year. Without this man's intimate knowledge of engineering and pharmacy, he would, undoubtedly, not have been given the responsibility and the opportunity which he received. He knew his chemistry; he knew his pharmacy; he knew his engineering; he was better qualified for the job.

Some of you may ask why so much stress on pharmaceutical engineering since anyone who desires such a combination of courses may obtain it at almost any university in the country. That is true; almost any university can give such a course. The important thing to do is to give it a name. There is much in a name. Show a prospective student a list of the subjects given in courses in medicine, dentistry, civil engineering, pharmacy or chemical engineering, without disclosing the name of the course to which each list belongs. In few instances will this have any meaning to the student; it does not enable him to visualize a vocation in which he might find himself particularly interested. Give the list a name, that is, suggest the name of the vocation or profession to which these subjects pertain and very likely in most instances the student will be able to visualize immediately his like or dislike for the calling. Where would medicine, dentistry, chemical engineering, mechanical engineering, civil engineering or pharmacy, if you please, be if they did not each have a name? The fact that each has a name is an indication of the fact that there is organization, that there is an organized course of study, and the fact that there is an organized course of study indicates that there is a definite goal or occupation, or profession which, once the student has attained to this degree of accomplishment, will permit the man to pursue the work of his choice. Should the words "Pharmaceutical Engineer," "Physician," or "Lawyer" never reach his ears, the prospective student would make his selection from other vocations with which he had become somewhat familiar.

Now that there is a need for it, a combination of engineering, chemistry and pharmacy, let us organize it and give it a name, a logical name: Pharmaceutical Engineering.

Since we are not aware that a course in pharmaceutical engineering is offered as such in any institution anywhere, we are submitting as a part of this paper a model of a curriculum which we consider to be a well-organized intensive course in pharmaceutical engineering. We think that the course should be one of six years of work. We do not believe that a course given in less time would be of the quality which should constitute such a course. When one considers that Law (at University of Minnesota) is six years, medicine seven years plus one year's internship, dentistry five years, and of equal length in other institutions, it is reasonable to believe that a course in pharmaceutical engineering of shorter length would not attract the high caliber of student which we often find in these other professions.

We do not believe it advisable to confer any degree in pharmaceutical engineering for less than six years of work as prescribed in the model curriculum. On completion of six years of work as outlined, we suggest that the degree "Master of Science in Pharmaceutical Engineering" be conferred; the degree "Pharmaceutical Engineer" to be conferred upon one holding the Master's Degree in Pharmaceutical Engineering only after a year's employment in a manufacturing plant where he has had an opportunity to, and actually does, apply the principles of pharmaceutical engineering to his work, and only then upon his submitting a satisfactory written thesis and its acceptance by the proper committee.

For those who desire the Doctorate we have suggested an outline of a curriculum for the seventh year's work for which the candidate, upon successful completion of the work, should have conferred upon him the degree "Doctor of Science in Pharmaceutical Engineering;" the degree of Pharmaceutical Engineer to be conferred in this case also, as suggested above.

It would probably not be possible for some time for colleges operating apart from universities to give a course in pharmaceutical engineering, except by arrangement with an engineering school or college, operating independently, to give part of the instruction. To turn the idea about somewhat, an independent college of pharmacy could obtain increased enrollment by influencing engineering schools to offer the course, "Pharmaceutical Engineering" and thus obtain these additional students for pharmaceutical instruction. Those colleges of pharmacy operating as departments or colleges within a university would have no difficulty in giving a course in pharmaceutical engineering except for the arranging of the class schedule, because all of the subjects suggested in our model curriculum are offered in practically all universities.

SUGGESTED CURRICULUM COURSE IN PHARMACEUTICAL ENGINEERING.***

FIRST YEAR:

Fall Quarter:

	Hours credit.
Rhetoric	3
*Beginning German I	4
Inorganic Chemistry and Laboratory	5
Botany	3
Shop Practice (Pattern Shop)	2
Pharmaceutical Latin	1

Winter Quarter:

Rhetoric	3
*Beginning German II	4
Inorganic Chemistry and Laboratory	5
Botany	3
Shop Practice (Foundry)	2
Pharmaceutical Latin	1

Spring Quarter:

Rhetoric	3
*Beginning German III	4
Inorganic Chemistry and Laboratory	5
Botany	3
Shop Practice (Forge)	2
Pharmaceutical Latin	1

SECOND YEAR:

Fall Quarter:

College Algebra	5
Qualitative Chemical Analysis	5
Theoretical Pharmacy	3
Organic Chemistry	5
Drawing and Descriptive Geometry	2
Pharmaceutical Arithmetic	1

Winter Quarter:

Trigonometry	5
Quantitative Chem. Analysis (Gravimetric)	5
Theoretical Pharmacy	3
Organic Chemistry	5
Drawing and Descriptive Geometry	2
Pharmaceutical Arithmetic	1

Spring Quarter:

Analytical Geometry	5
Quantitative Chemical Analysis (Volumetric)	5
Theoretical Pharmacy	3
Organic Chemistry****	5
Drawing and Descriptive Geometry	2
Pharmaceutical Arithmetic	1

THIRD YEAR:

Fall Quarter:

Differential Calculus	5
Physiology	4
**Physics (Mechanics) and Laboratory	4
Materia Medica	3
Pharmacognosy	2

Winter Quarter:

Integral Calculus	5
Chemical German	3
**Physics (Electricity)	3
and Laboratory	1
Materia Medica	3
Pharmacognosy	2

Spring Quarter:

Technical Mechanics (Statics)	5
Advanced Chemical German	3
**Physics (Heat and Sound)	3
and Laboratory	1
Materia Medica	3
Pharmacognosy	2

FOURTH YEAR:

Fall Quarter:

Technical Mechanics (Dynamics)	5
**Physics (Optics)	3
and Laboratory	1
Manufacturing Pharmacy	5
Physical Chemistry	5
Pharmaceutical Jurisprudence	1

Winter Quarter:

Hydraulics	4
Hydraulics Laboratory	1
Manufacturing Pharmacy	5
Physical Chemistry	5
Biological Assay of Drugs	3

Spring Quarter:

Bacteriology	4
Therapeutics—Pharmaco-Dynamics	3
Manufacturing Pharmacy	5
Physical Chemistry	5
Public Health, Hygiene and Sanitation	2

FIFTH YEAR:

Fall Quarter:

Strength of Materials	4
Electrometric Measurements and Titrations	3
Electric Power	3
Dispensing Pharmacy	5
Machine Design	3

Winter Quarter:

Heat Engines	4
Electrometric Measurements and Titrations	3
Electric Power	3
Dispensing Pharmacy	5
Food and Drug Analysis	3

Spring Quarter:

Heat Engines	3
Unit Processes	4
Electric Power	3
Dispensing Pharmacy	5
Food and Drug Analysis	3

SIXTH YEAR:

Fall Quarter:

Unit Process Problems	2
Applied Electrochemistry	3
Design of Chemical Equipment and Plants	2
Intermediates and Dyestuffs	3
Industrial Inorganic Chemistry	4
Chemical Manufacture (Inorganic)	3

Winter Quarter:

Unit Process Problems	2
Applied Electrochemistry	3
Design of Chemical Equipment and Plants	2
Industrial Organic Chemistry	4
Chemical Manufacture (Organic)	3
Thesis	3

Spring Quarter:

Unit Process Problems	2
Design of Chemical Equipment and Plants	2
New and Non-Official Remedies	2
Thesis	12

SEVENTH YEAR:

Fall Quarter:

Advanced Organic Chemistry	3

	Hours credit.
Advanced Organic Chemistry Laboratory	2
Advanced Physical Chemistry	4
Advanced Theoretical Physics	5
Differential Equations	3
Winter Quarter:	
Advanced Organic Chemistry	3
Advanced Organic Chemistry Laboratory	2
Advanced Physical Chemistry	4
Advanced Theoretical Physics	5
Advanced Calculus I	3
Spring Quarter:	
Advanced Organic Chemistry	3
Advanced Organic Chemistry Laboratory	2
Advanced Physical Chemistry	4
Advanced Theoretical Physics	5
Advanced Calculus II	3

* Students who have credit for two years of German in High School will take electives in the first year instead of beginning German. Two quarters of Zoölogy and one quarter of History of Pharmacy are especially recommended. Other subjects of value to the Pharmaceutical Engineer are Economics, Plant Management, Personnel Management, Labor Problems, Economic History of the United States.

** One year college Mathematics pre-requisite to these courses in Physics.

*** Description of practically all courses will be found in bulletins of the Chemistry School and Engineering College of the University of Minnesota, though bulletins of other colleges of Pharmacy were also referred to in arranging the suggested curriculum.

**** Those students who wish to pursue additional courses during summer sessions or during the regular sessions in case they already have credits for certain subjects, are urged to pursue work in Physiological Chemistry and as much other work in Biological Chemistry as possible.

A LIBRARIAN'S STORY.*

BY JOHN URI LLOYD AND JOHN THOMAS LLOYD.

"Are there not curious incidents connected with the collecting of books that form the library of a specialist?" the senior author of this paper was asked.

"Yes, some of them a novelist would hesitate to introduce because they might seem utterly unbelievable. Often do I reflect over them as mind turns to the past." Briefly, a few may be related.

When our library was begun there was no thought of collecting books except for personal service in our work on American plants and their products which demanded authentic historic references. Among these the two volume publication of the talented but erratic scientist, Rafinesque, issued in 1830 and 1832, serves as an example. Repeatedly this work was mentioned in writings on American materia medica, but the books were not available; even Dr. John King's library did not contain them. Second-hand book stores did not have them. Advertisements in booksellers' magazines as well as in the journals of the Eclectic, Thomsonian and Homœopathic schools of medicine failed to bring the desired response. Even from the library of Transylvania University, Lexington, Kentucky, where Rafinesque taught, his publications had vanished. Finally our search for them was abandoned.

Years later an aged physician in Indiana wrote that in his preceptor's library he had found a two-volume publication on American materia medica that might interest us. The title he gave was that of the rare work of Rafinesque. Our response was immediate—"Send it to us with bill." It came with pages uncut.

* Section on Historical Pharmacy, A. PH. A., Miami meeting, 1931.