Motion was made that the address be received, and published; carried.

The following papers were read and discussed:

"Suburban Pharmacy Can Be Made Profitable if Conducted in Accordance with Advanced Business Methods," Fred W. Ames.

"Separation of Pharmacies Not Necessary," Robert P. Fischelis.

"Shorter Hours," "How to Meet Effectively the Prevailing Cut Rate Competition," "How to Successfully Build up a Truss Business," by I. Lewyn.

Messrs. E. F. Cook, Clyde M. Snow and Charles S. Koon were appointed members of the Nominating Committee. They reported at a second session of the Section held September 8. The following officers for the ensuing year were elected:

Chairman, Charles W. Holzhauer, Newark, N. J.

Secretary, B. H. Eichold, Mobile, Ala.

Associates, J. H. Webster, Detroit, Mich.; Fred W. Ames, New Orleans, La.

Mr. L. O. Watt of St. Louis delivered an address on "The Interdependence of Dyes, Coal Tar Medicinals, Fine Chemicals and Explosives," which was well received, and a motion by E. F. Cook was carried endorsing a protective tariff on these products.

The Section adjourned after announcement of the officers-elect. The address referred to was delivered under direction of the Chemical Foundation, and the request made by the Section that it be published, it follows:

THE INTERDEPENDENCE OF DYES, COAL TAR MEDICINALS, FINE CHEMICALS AND EXPLOSIVES.

BY L. A. WATT.

Pharmacy has a keen interest in the future of the Synthetic Organic Chemical Industry. Not only through the long list of medicinals which are now standard, most of which may be obtained "American Made," but the prospect and hope for the future development of new and equally as important ones, add to that interest.

Most that we have heard and read recently has not been relative to the possibility of having a complete industry in America but rather the desirability or necessity of having it and the means of overcoming what we hope are its temporary difficulties.

Until 1914 we were dependent on Germany for our supplies of organic chemicals. It speaks well for the ability of the men in our industry to-day, therefore, to say that the importation of either finished or crude materials for practically all of the staples and many rarer products is unnecessary. We must remember, however, that it was under the pressure of war-time necessity that we made provision, often extemporaneously, for supplying war gases and many of the unavailable dyes and synthetic medicinals. Under the conditions it is not surprising that many plants were neither designed nor operated on a basis comparable with the efficiency of our European competitors who have some fifty years' experience. Quick production in quantity was the demand with price a secondary matter.

Relatively, we have been in a position similar to that of the meat packer in the early days of his industry. He slaughtered for meat and hides only and in the easiest way possible disposed of the other products. This waste included much which was edible, certainly the ductless glands and other products from which many pharmaceuticals are now derived. The recovery of these was a great economic gain but the intricacies, the well-advertised commercial recovery of by-products from the modern American abattoir is not comparable with the multitude of by-products of the Organic Chemical Industry.

Withal, our American Industry is in advance of that in England or France but it is by no means on a par with that of Germany. Germany's industry is prosperous. It was her mainstay in war time, profiting of course both financially and in added experience. Now it is organized as one huge trust which includes all of the large plants which by their agreement will exchange processes, divide foreign trade and pro-rate profits until the year 2000. We can agree that Germany is looking ahead.

To borrow from the classification of Dr. Slosson's "Creative Chemistry" our Chemical Industry is partly in an appropriative, partly an adaptive and partly in a creative stage. The creative part has been subordinated while we followed the processes of others in getting a start

on some of the essential products. It is time now to branch out along original lines, to think for ourselves, while keeping the established processes going. I shall stress this point a little later.

We may refer to the Organic Chemical Industry as interwoven or interdependent. In no others of our Industries are operations so nearly duplicated as in the several branches of this industry. These interrelationships have been very well illustrated in an exhibit prepared by the Chemical Warfare Service.

In this an idealized self-contained chemical industry is shown in the form of a model. The four most essential crude materials are supplied: (1) coal from a mine; (2) sulfur from wells as in our Gulf region; (3) salt from brine wells; (4) nitrogen from an atmospheric nitrogen fixation plant. These are supplemented by a by-product coking plant, a sulphuric acid and an electrolytic chlorine and caustic soda plant.

The relatively few crude intermediates are delivered to four different branches of the industry, namely, dyestuffs, medicines, explosives and war gases. Beginning with the basic crude materials and following through to the final products, a representative lot of their derivatives have been shown graphically. Without following these in such detail as to be tedious let us trace a few products in each class in order to more clearly demonstrate the intricate nature of the industry.

REFERENCE TO CHARTS.*

Sulphur.—We are all familiar with the products of sulphur especially those which follow the trail through sulphur dioxide and sulphuric acid. Sulphur dioxide is used extensively in the wood pulp and paper trade; sodium bisulphite as a bleaching agent. Sulphuric acid is mixed with phosphate rock from Tennessee or Florida to make thousands of tons of superphosphate, an important fertilizer. Ammonium sulphate is a by-product of the gas works and copperas of the steel and wire mills. The latter is used as a mordant for ink and as a coagulant in the purification of water.

From sodium sulphate, sodium sulphide finds an outlet in sulphur colors and as the basis for thiosulphates. Medicinals such as the pheno-sulphonates are made from sulphuric acid.

Taking up the other branch of the chart, by treating sulphur with chlorine we obtain a liquid, sulphur chloride, and on treating this with ethylene a compound is obtained which has been christened chemically, dichlor-diethyl sulphide, but which is the well-known mustard gas. Another use for sulphur chloride is in the vulcanization of rubber.

Coal.—Of the thousands of coal-tar products only a few may be chosen for purposes of illustration.

Toluene, differing from benzene only by the addition of a methyl group yields on the further addition of three nitro groups trinitrotoluene, the much-used T. N. T. If the toluene be oxidized the resulting product is benzoic acid the sodium salt of which is widely used material for food preservation. Other and more complex treatments result in the important gas brom-benzyl-cyanide, or of the dye congo red.

Toluene is also the starting point for the important sweetening agent or condiment, saccharin, which results on conversion to toluene sulphon chloride, amidating and oxidizing. In the process two forms of the sulphon-chloride are obtained, the ortho- and para-compounds, respectively. Only the ortho compound is of value for saccharin and the para is a by-product. The search for an outlet for this has led to the production of an intermediate for an important red lake and furnished a material for making the antiseptic chloramine-T which was developed so successfully during the war. The ester of the same by-product was used as a softening agent for aeroplane dope. Thus we have an explosive, a preservative, a sweetening agent, a dye, a medicine and a product which is useful mechanically, all from the original toluene.

Benzene is the starting point for the majority of dyes and synthetic medicinals. This is ordinarily first converted to nitro-benzene, then transposed to aniline and from this as a "substation" the syntheses begin. We have as examples diphenyl-chlorarsine, a war gas; butter yellow; and ponceau, one of the certified or "permitted" colors for use in foodstuffs.

Carbolic acid is obtained from coal tar or indirectly from benzene. One of its greatest commercial uses is in the manufacture of the synthetic resins—bakelite, condensite and redmanol.

* The charts shown were prepared from photographs of an exhibit by the Chemical Warfare Service, to show what the chemist has done and may do.

These are being used extensively for electrical work, in printing and for phonograph records. Picric acid, high explosive and dye, and chlorpicrin, the war gas, are other products.

Any reference to benzene should include mention of salicylic acid (made from phenol) and its compound with acetic acid-aspirin. As a result of advertising and litigation this has become as well known to the layman as epsom salts.

Naphthalene (not shown on the chart) is produced in large amount from coal tar but its former use for moth balls is now of minor importance. It is converted to phthalic anhydride in large quantity and the latter is used as a dye intermediate or for the manufacture of phenolphthalein which in variously colored tablets and under many labels has one of the widest distributions of any medicinal. And as for the moth balls the modern substitute on sale in most drug stores, perhaps not under that name, is para dichlor benzol. This is more effective, has an odor which is not unpleasant and, moreover, disappears quickly on exposure.

Air.—The chemists' conquest of the air is also a fruitful source of products falling within our classification. Oxygen finds an extensive use in oxyacetylene welding and a limited but important one in medicine. It also enters into the war gas and dye intermediate phosgene. Since oxygen could be obtained in other ways, however, for example as a by-product from commercial hydrogenation plants, nitrogen must be considered the principal product. Through its fixation as ammonia or of nitric acid or as shown, as calcium cyanamid we may derive a variety of products: fertilizer material; an anesthetic, nitrous oxide; explosives, nitroglycerin, ammonium nitrate, and cellulose nitrate; and the war gas chlorpicrin.

Germany was able to stay in the war after England shut off her supply of Chile saltpeter by means of a blockade only because of her advanced position in nitrogen fixation. We were also to the point where the supply of the natural nitrate was limited. The war ended before our fixation plants were put in operation, but it is now proposed to sell or lease these to a private corporation which will operate them on a peace-time basis largely for producing fertilizer. For this purpose we are in need of a great quantity at a low price and the existence of these plants as going concerns would be invaluable in case of war.

Salt.—The products of salt extend somewhat beyond the limits which may occur to one. Since the production of chlorine by the electrolytic decomposition of brine its field of usefulness has been rapidly enlarged. The water supply of nearly all large cities and many industrial supplies is sterilized with chlorine. The salt industry is an important contributor to dyes, medicinals, and war gases. Mere inspection of the chart is sufficient to show its ramifications.

The object of this exhibit is to impress one with the fact that a number of products come from identical materials and that the processes to which they are subjected have many similarities. A dye factory may enter the manufacturing of war gases over night and consequently with but minor changes. The chemical staff may likewise enter war service with facility and it is possible that one chemist could be worth a hundred or a thousand civilian soldiers.

With the advantage which we hold by virtue of our $200,000,000 investment, several years' experience and well-located crude materials just what does the future promise for the industry in America? We have yet to meet the man who is willing to go back to our pre-war status. The various reasons why we wish to hold and further develop our American industry may be summarized under the following headings:

First.—In this way only can we insure a supply of chemical products, dyes, medicinals, etc., independent of foreign blockades, embargoes, industrial warfare and the like, to any or all of which the race is still heir.

Most of us will recollect with what difficulty and at what a price certain dyes and chemicals were obtained in the early years of the war. Compare the condition, then, when aspirin was dealt in ounces at wholesale and salvarsan was subject to an embargo by Germany, with a later period when both were obtainable of American make. But that interval was uncomfortable and dangerous to our people.

Again, Count Bernstorff recognized the strategic position when he wired his government that an embargo on dyes would throw 4,000,000 American workmen out of employment.

A supply of dyes for our postage stamps was the subject of an embarrassing appeal to the German government and then we had to ask the English to let us hire the Dutch to haul it over to us.

Not only in time of actual hostilities are such instances possible but also in industrial crises when the withdrawal of a certain necessary dye may be used as a club to induce the purchase

of others. This is of course the familiar "full line forcing," and we shall always be subject to such tactics unless our industry is complete.

Second.—We want a complete, self-contained chemical industry for purposes of defense.

With no malice we can use the case of Germany as an illustration, for, deprived of all her navy, artillery, machine guns and such paraphernalia, she will still have her chemical industry and staff intact. And with chemical warfare occupying 55% of the stage at the close of the recent conflict we need only suggest the possibilities for her success against a nation not similarly equipped. This is not a new form of competitive armament. Our provision for defense along these lines is thoroughly in accord with the reduction in all armament which must come.

We hear it frequently now that 80% of the revenue collected by the Federal Government goes to pay for war past and preparatory. Only 20% is applied to all other lines including running the Government. To save even part of 80% ought to permit a little more progress downward in that tax revision puzzle. The day of the $30,000,000 warship with a $3,000,000 annual appropriation for upkeep and depreciation is passing. Products for defence must also pay their way in peace time and in this, war gases give great promise. The prayer of the southern and mid-western farmer that he be delivered from the plague of the boll weevil, locust, army worm or chinch bug may yet be answered. This and the destruction of insects in stored grain are important problems for which organic chemistry promises a remedy.

It is only through and on account of a self-contained, complete chemical industry that real disarmament is possible and it would represent a net gain to the individual even assuming that dyes cost us twice as much for a few years as the price for which they might be imported.

Third.—The maintenance of competent research workers is essential to our progress.

We are developing as an industrial nation and in order to be successful our progress must be along broad basic lines. Organic chemistry not only offers an opportunity for those properly equipped for working in its field to gain their livelihood but it serves as an excellent training ground from which other industries may draw competent scientifically trained help. Without such an industry the opportunities for the development of the individual must be more limited. It was just such a lack of help which led Perkin to abandon his efforts to establish the dye industry in England thus permitting its transplantation in Germany where Ph.D's in the sciences were common and energetic.

The dye industry is peculiar in that a relatively large number of men are employed in research. Problems which arise daily are not covered by the literature and thus require not only a native ability but training in the methods for handling such work.

Pharmacy is vitally interested in this because it is mainly through the dye industry and its staff that advance in the synthetic medicinals is to be expected. A classic example was Ehrlich's appeal for the facilities of the great Cassella dye plant in his work on salvarsan. Medical research follows inevitably the complete dye industry. The never-ending search for an outlet for by-products or for excess production lends itself in this direction. Many products formerly derived from natural sources exclusively have been synthesized. Among them have been camphor, cocaine, even adrenalin. And in many cases the beauty is that the substitute is free from impurities and thus capable of closer standardization.

Fourth.—Our pride in leadership and our vision of the future require the maintenance of a complete chemical industry.

One of the outstanding characteristics of our nation has been our recognized ability to keep to the front in engineering and mechanical progress. From their inauguration America has led in the development of the steam engine, railway transportation, sewing machines, typewriters, telephone and telegraph, bridge building, modern reinforced concrete construction, the application of electrical equipment, the phonograph—in which of these lines have we not been either the originator or the leader?

But the possibilities for development in this direction are approaching a limit. The future must hold more in the way of improvement than of discovery.

On the other hand chemistry is only entering upon its era. An example is the case of the recent war which started with the exclusive use of explosives and ended with the use of 55% of toxic gases. The field of dyestuffs has not been exhausted but has been thoroughly explored, that of synthetic medicinals has been only touched. It offers one of the greatest opportunities in all history for allaying the suffering of man. Who will say, for instance, that the limit in anesthetics has been reached and may we not make contribution to the search for a cancer remedy?

The introduction of such materials as the synthetic resins, of electrolytic graphite, of the modern abrasive, carborundum, are but instances of American contributions of far-reaching effect. The engineer can make waste land available for crop production but with the constant increase in population the duty of the chemist of the future will be to provide for an increased production from the same area. His efforts must be constructive and creative rather than adaptive.

To take her proper place in the future, America must have a complete, self-contained chemical industry. For this we now have an excellent nucleus. Our industry is practically sufficient for the present but for a few years the American manufacturers will need protection:

(1) To permit rehabilitation of plants built extemporaneously during the war.
(2) To improve and standardize processes and establish outlets for by-products.
(3) To develop a corps of men experienced in the work.
(4) To offset the difference in labor costs and the effect of the present exchange rate which gives Germany a tremendous advantage.

Labor in Germany now costs approximately one-seventh as much as in America.

The American manufacturers have gone before the proper congressional committees and frankly stated their case, at the same time submitting a plan for an embargo for five years on the importation of all intermediates, dyes, drugs and coal-tar chemicals which are produced in this country in sufficient amount, of satisfactory quality and at a fair price. England, France, Italy and Japan have similar provisions lasting for ten years.

The proposed Fordney tariff bill provides for a duty of but 35% ad valorem plus 7c per pound which it has been demonstrated is inadequate.

In conclusion I shall make two quotations bearing on the subject: One from the *Deutsche Allegemeine Zeitung*, May 1920 (before the European or Japanese embargoes were passed), tells how little effect a tariff will have. It says:

"The American Government has deliberately excluded German products in refusing them the necessary import license. On the contrary, in other countries we have recouped our before-the-war superiority. All companies established since 1914 are in difficulty and those founded in Sweden during the war now have completely disappeared."

"The German Color Trade does not conceal its dreams of reconquering foreign markets through the elimination of the competitors, but the experience with America teaches us what is the most effective obstacle in our path."

There Germany submits proof of our case.

And in approval of the proposed embargo Mr. Water, President of the Master Dyers' Association of Philadelphia has said: "The beauty of this plan from the customer's point of view is that the dye user can secure all dyes that he really needs whether made by American manufacturers or not and that all dyes imported under licenses can still be subjected to a reasonable tariff to provide revenue for the country. It furnishes insurance against unreasonable prices and bad quality in American production because licenses will have to be issued for dyes and types made in America if makers charge too much or turn out bad goods. This license feature would be only a temporary measure for four or five years until our American manufacturers are firmly established in their business."

The Cartel is a formidable adversary for an adult industry but the American Chemical Industry has not reached that stage. The German dye industry has a reputation for ruthlessness, full line forcing, selective attack and every known vicious trade practice. We already have instances of their returning to the old methods.

Pharmacy has not only a friendly but ultimately a financial interest in the problems of the Chemical Industry.