

which make for poison gas or liquid gas, which is forbidden, the thought being that Germany was the only nation in the world that would start any such thing.

SENATOR CHAMBERLAIN—Well, I think there are others, if they had had the chance.

The provision in the Peace Treaty by which, according to General March, "Germany is forbidden to import into her territory any of the elements which make for poison gas or liquid gas" doubtless gives to the Germans the same sense of despair that America would feel if, at the conclusion of an unsuccessful war, it were forbidden "to import" cotton for use in the manufacture of guncotton or iron ores for making steel for guns.

#### COÖPERATION IN CITY DISASTERS

Coöperation should, however, not be confined to national affairs. Within the last few days a terrible disaster has occurred in New York City. As a result of the work of perverted minds, many citizens were instantly killed and many more horribly mangled. The evidence which would determine the cause of such a disaster and trace its perpetrators is largely chemical. The time to utilize the chemist in such a situation is immediately after the disaster takes place. In the New York Section of the AMERICAN CHEMICAL SOCIETY more than two thousand chemists are numbered, among them men who are specialists in explosives, in metallurgy, and in cement. No one of these men, no matter how prominent or how immersed in his own laboratory, could as a patriotic citizen decline an invitation to serve on a committee advisory to the city authorities in such cases of great disaster. Provided with official passes through the police lines they could be of invaluable service through their special knowledge and acumen. For such public service they would desire no pay. There is a civic asset here which is lying neglected and which can be quickened into dynamic aid by a simple request from the municipal authorities.

#### COÖPERATION IN THE ALLEVIATION OF HUMAN SUFFERING

Fortunately the future energies of our chemists are not to be confined to increasing the wealth of the country and providing means for its defense. There is a higher goal ahead for American chemistry, it is the alleviation of human suffering. The normal, healthy, vigorous human being is a mass of chemical reactions which can be called normal. When these become abnormal we speak of disease, and disease entails suffering. About many of these subtle changes we know little. In our blind efforts to restore normality we try this and that drug, sometimes with success, many times with utter failure. Eminent authorities inform me that of the many synthetic medicinals sold by Germany to this country only from three to five per cent have proved of real value. We know in general terms the results from the use of drugs, but of the fundamental reactions induced by their use we know but little. These changes in the body effected by drugs are chemical changes, but in their study in the past the chemist has played but a minor part, and we have been content to continue the "cut and try" process in our efforts to heal. It is now proposed to give the chemist the leadership in this his own line of research. But he is not qualified to work out the problem alone, for the conditions are very complex. He must be associated with the pharmacologist and the experimental biologist. With the focusing of these three types of mind upon the problems of health, under conditions of constant association and adequate experimental facilities, real progress can be made, even though slowly, in the alleviation of suffering. It is a task worthy of the best efforts of our very ablest men. Funds will be required for its prosecution. Fortunately the Chemical Foundation, Inc., which under its charter must spend all above six per cent of its earnings on scientific research, sees in this direction the channel through which it can best perform its

mission. It has therefore pledged a sufficient amount for immediate use to insure the inauguration of this work. It is confidently believed that as the work takes definite shape and progresses it will make its own appeal to those generous Americans who have never yet failed to respond to the cause of humanity when convinced that the right way to aid has been shown them.

### PROGRESS OF THE AMERICAN COAL-TAR CHEMICAL INDUSTRY DURING 1919

By Grinnell Jones

CHIEF CHEMIST OF THE U. S. TARIFF COMMISSION

A year ago, the annual census of dyes and other coal-tar chemicals, prepared by the Tariff Commission, was published on June 11. This year it has been unavoidably delayed owing to the fact that a general census of manufactures of all kinds is being taken by the Bureau of the Census. In order to avoid having two different branches of the Government each send its questionnaire to every manufacturer, it was arranged that the collection of the reports should be undertaken by the Census Bureau, whereas the tabulation and interpretation of the reports on dyes and coal-tar chemicals would be done by the Tariff Commission. The Census Bureau has secured reports from a number of small manufacturers who were unknown to us. However, the collection of the reports has been much delayed by the cooperative arrangement, and the reports of over a dozen firms have not yet been turned over to the Tariff Commission. However, the missing reports are all believed to be of small firms. I am confident that our records are sufficiently complete to show clearly the progress made during the year, but any figures given are subject to revision upward.

The Geological Survey has recently reported that the production of by-product coke and the by-products obtained therefrom during the year 1919 shows a slight decrease, as compared with 1918. This was due to labor troubles in the steel and coal-mining industries and to railroad congestion. There appears to have been a small decrease in the amount of tar distilled and a large decrease in the output of pure benzene, and especially of pure toluene. This means that a much larger proportion of the output was sold as mixtures for solvent purposes or as motor spirit, instead of in the purified condition. Of more significance in considering the future of the coal-tar chemical industry is the fact that the productive capacity of the by-product coke ovens in the United States increased 17.2 per cent during 1919. There is no question that, with the possible exception of anthracene, adequate supplies of the fundamental raw materials of coal-tar origin will be available from American sources for the growth of the industry.

#### THE PROBLEM OF ANTHRACENE SUPPLY

In the case of anthracene considerable progress has been made during the past year, but the problem of securing adequate supplies is still unsolved. In 1918, the anthracene content of the crude anthracene produced was about a quarter million pounds, but very little of this was refined. In 1919 the output of crude anthracene was about three times the 1918 record, and a much larger fraction of it was refined. Although this shows great and encouraging progress, a much greater increase in output must be secured before there will be enough American anthracene available to supply the American demand for alizarin and vat dyes. It may be roughly estimated that the 1919 production of crude anthracene contained less than one-fifth of the amount of anthracene which would be required to supply the American needs. The difficulty is not primarily an actual lack of anthracene in the ter or purely technical difficulties in its recovery, but rather

the fact that its removal leaves the pitch so hard that it does not find a ready market under American conditions. In England and Germany large amounts of hard pitch were used for the briquetting of coal dust and coke breeze, but this industry is very little developed in the United States. Any method of recovering anthracene which seriously disturbs the marketability of the other larger fractions of the tar, especially the pitch, would make the anthracene so expensive that the dyes derived therefrom could not be made on a competitive basis.

This problem of securing supplies of anthracene adequate in amount and at a cost which is not prohibitive is perhaps the most important and most fundamental problem still awaiting solution in this industry. Whether it will be solved by the tar distillers or by the development of a synthetic process for making anthracene or anthraquinone cannot be determined at the present time. Active work along both lines is now under way and the progress already made is encouraging.

#### THE PRODUCTION OF INTERMEDIATES

As was to have been expected, there was a large decrease in the output of several intermediates needed primarily for explosives. This is most noticeable in the case of phenol, which showed an enormous production—106,000,000 lbs.—in 1918, but fell to less than 1,500,000 lbs. in 1919, nearly all of this being obtained from coal tar. A less conspicuous case is the decrease in the output of monochlorobenzene from 20,500,000 lbs., in 1918, to a little more than 4,000,000 lbs. in 1919. There was also a considerable decrease in the output of several intermediates required for making dyes used for army uniforms; for example, there was a 25 per cent decrease in the output of *m*-toluylenediamine, which was used for making a khaki dye for cotton uniforms, and a 90 per cent decrease in *m*-nitroaniline, which was used for making a khaki dye for wool uniforms. It is my purpose to-day to give some typical examples of the progress of the American coal-tar chemical industry under peace conditions.

A comparison of the intermediates produced in 1918 and 1919 shows a considerable increase in the number of intermediates and substantial increase in amount in many cases. In 1919 there were about 225 different intermediates produced, against about 140 in 1918. The new intermediates are, of course, comparatively difficult to make, but were needed for dyes and medicinals of the better class. Among these new intermediates may be mentioned bromobenzene, dibenzylaniline, dichloroaniline, nine new sulfonic acid derivatives of naphthol or naphthylamine,  $\beta$ -oxynaphthoic acid, and five new anthraquinone derivatives.

As a rule, the intermediates for which there is the largest demand, and whose manufacture had been well established by 1918, show comparatively little change in 1919. Thus, nitrobenzene gained 11 per cent, the 1919 output amounting to about 42,500,000 lbs.; the output of aniline was about 24,500,000 lbs., a gain of 1 per cent; *p*-nitroaniline, with an output of about 1,300,000 lbs., lost 1 per cent; and  $\beta$ -naphthol, with an output of about 5,000,000 lbs., dropped 6 per cent. The output of H acid increased from a little less than 3,000,000 lbs., in 1918, to about 4,000,000 in 1919; on the other hand, the output of dimethylaniline fell off about 15 per cent, amounting to 3,500,000 lbs.

There are many notable increases in the output of individual intermediates, especially noticeable in the case of those derived from toluene or from anthracene. The output of U. S. P. benzoic acid increased from about 173,000 lbs., in 1918, to over 600,000 lbs. in 1919, with a drop in valuation from \$3.07 to 74 cents per lb. *o*-Toluidine increased from 639,000 lbs. to a little over 1,000,000 lbs., and *p*-toluidine from about 200,000 lbs. to over 575,000 lbs., with a drop in valuation per pound to nearly

half the 1918 figures. The general increase in the output of intermediates derived from toluene is, of course, due to the relaxation of the restriction on the use of toluene during war times.

There are also many examples of a big increase in the production of intermediates which are difficult to make, but are required for dyes of the best quality. A good example of this kind is amidonaphthol sulfonic acid, 2:8:6 (gamma acid), which was made in 1918 by a single firm, but in 1919 by five firms, with an output of over 155,000 lbs. valued at \$667,000, which is many times the 1918 output. These five firms used this gamma acid to make nearly a half million pounds of Oxamine Black—an important direct black which can be developed. Moreover, gamma acid also went into Diamine Fast Red F, Neutral Gray G, and Columbia Black F B—all of them important direct cotton dyes of faster type.

Other intermediates, whose output increased substantially, include metanilic acid, with an output during 1919 of 450,000 lbs.; ethylbenzylaniline, which served for the manufacture of Acid Violet; Michler's ketone (280,000 lbs.) used mainly for the important dye Auramine; thiocarbanilide (2,250,000 lbs.) used as an accelerator for vulcanizing rubber; naphthylamine sulfonic acids 1:5 and 1:8; and amidonaphthol sulfonic acid 1:2:4 (about 900,000 lbs.), important naphthalene derivatives.

The progress among the anthracene derivatives is of especial interest. Here, unfortunately, definite figures cannot be given without revealing confidential information. In 1919, there were ten intermediates derived from anthracene, against only five in 1918. The output of anthraquinone, which is the most important because it serves as raw material for the manufacture of nearly all other intermediates derived from anthracene, was about ten times as great in 1919 as in 1918.

#### THE PRODUCTION OF DYES

The total output of all dyes increased about 8 per cent over 1918, or to a little more than 63,000,000 lbs., valued at about \$67,000,000. The average value per pound was \$1.07, which is just the same as shown by the 1918 census. The average quality of the dyes has, however, improved considerably, owing to a partial replacement of many of the cheaper dyes by others of a more satisfactory character. The consumer, accordingly, received better value for his money in 1919 than in 1918.

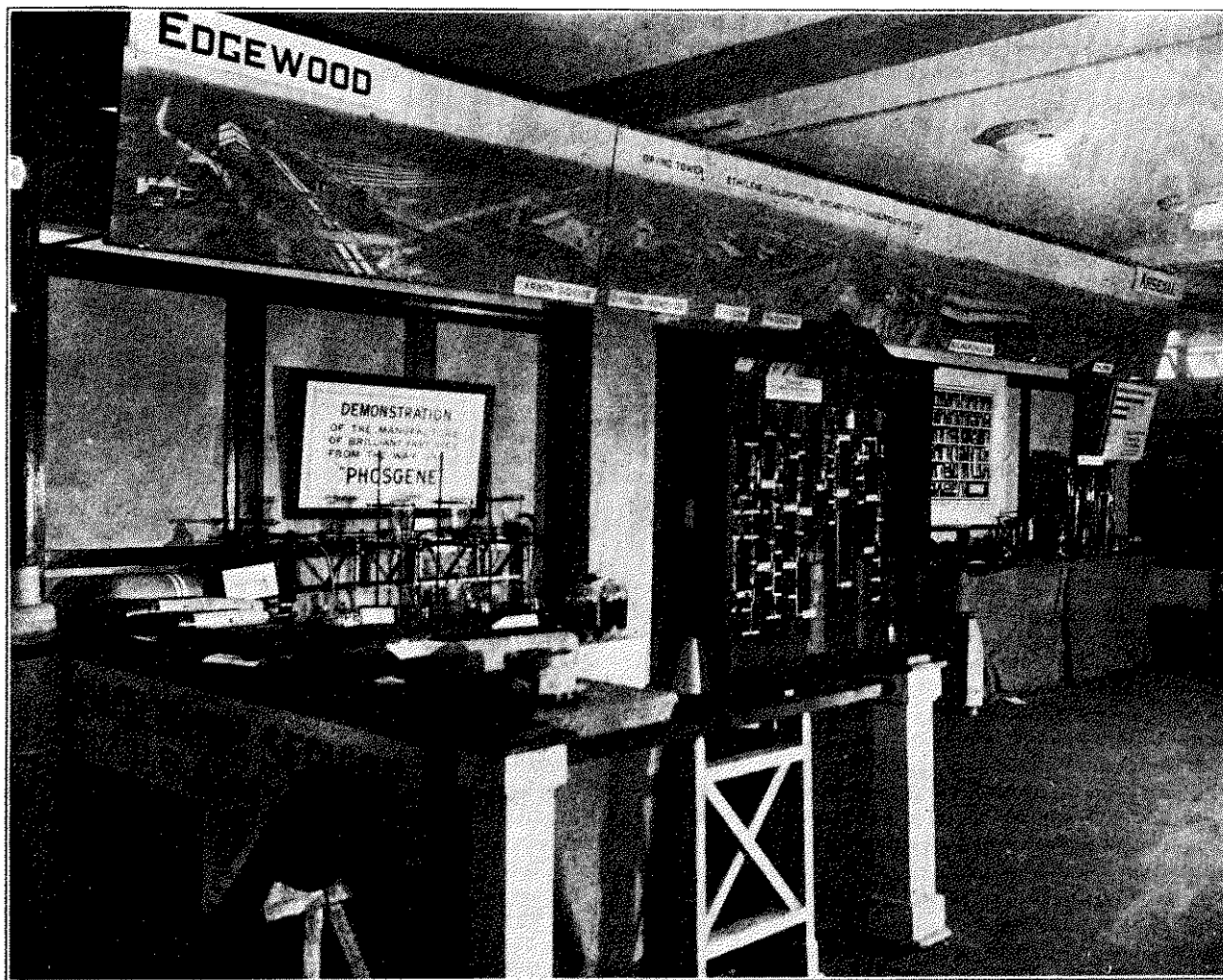
The production of basic dyes for 1919 was over 4,000,000 lbs., an increase of more than 1,000,000 lbs., as compared with 1918. The production of Magenta, Victoria Blue, Malachite Green, and Bismarck Brown more than doubled, while Auramine nearly trebled. There has been a conspicuous increase in the production of Rhodamine B.

The production of direct dyes was about 14,500,000 lbs., an increase of 2,000,000 lbs., as compared with 1918. About half of this total was direct Deep Black E W. Conspicuous changes include large increases in the output of Chrysophenine, Primuline, Oxamine Black, Diamine Rose, and the first appearance of Diamine Fast Red F.

The production of mordant dyes during 1919 was over 3,100,000 lbs., which is about 2,300,000 lbs. less than the output of mordant dyes in 1918. This decrease is due principally to a diminished production of Alizarin Yellow G G and R of more than 2,000,000 lbs. Mordant dyes available in 1919 in considerable, although inadequate, amounts, included alizarin, Alizarin Saphirole, and other alizarin derivatives, as well as a considerable number of fast mordant dyes for wool dyeing and mordant printing.

The production of acid dyes for 1919 was over 14,000,000 lbs., an increase of about 6,000,000 lbs. over 1918.

The production of indigo, 20 per cent paste, reached 8,863,824 lbs., valued at \$5,233,719. This exceeded the 1914 importation



CHEMICAL WARFARE SERVICE EXHIBIT

by 356,465 lbs., and the 1918 production by 5,779,936 lbs. Several indigo derivatives were placed on the market. Four other vat dyes were made on a commercial scale during 1919, but the output was only a small fraction of the pre-war consumption. However, fundamental progress has been made in this important field.

The total production of sulfur colors for 1919 was over 17,000,000 lbs. This was about 6,000,000 lbs. less than that for 1918. This was largely due to a decrease of about 8,000,000 lbs. of sulfur olive and khaki dyes required in the war period for cotton uniform cloths. Sulfur black production in 1919 (14,250,000 lbs.) was about 2,000,000 lbs. more than that for 1918.

#### COAL-TAR MEDICINALS AND PHOTOGRAPHIC DEVELOPERS

Among the coal-tar medicinals there has been a substantial increase in the output of many items already well established in 1918, including aspirin, acetphenetidin, arsphenamine, guaiacol, and methyl salicylate. Moreover, a considerable number of new products have been introduced on a small scale.

In the case of photographic developers of coal-tar origin, there was a decrease of 30 per cent in the output of hydroquinol—to about 200,000 lbs. valued at nearly half a million dollars. On the other hand, the output of metol increased more than five times—to nearly 60,000 lbs., and *p*-aminophenol increased about 7 per cent, or to over 130,000 lbs.

The many difficult problems in readjustment from war conditions to peace conditions have been met with encouraging success. The achievements of American chemists in these industries furnish an excellent basis for optimism as to the future.

#### REORGANIZATION OF THE CHEMICAL WARFARE POST OF THE AMERICAN LEGION

Major L. T. Sutherland presided at the reorganization meeting of the Chemical Warfare Post of the American Legion, and introduced Brigadier General Amos A. Fries, the present head of the Chemical Warfare Service, who outlined the plans of the Service and made an earnest plea for the cooperation of civilian chemists with the military organization.

General Fries pointed out the difficulty of educating, in times of peace, to the necessity of preparing for chemical warfare, both in the offensive and defensive sense. He cited statistics recently given out by the Army to the effect that three out of every ten casualties in the World War were due to gas and one-third of the wounds inflicted were also due to gas attacks.

General Fries voiced the appreciation of the Chemical Warfare Service for the aid that has been given by civilian chemists to obtain proper recognition for the Service.

Civilian chemists and particularly former officers of the Chemical Warfare Service will be called upon frequently, said General Fries, to aid in the work of the Army, and a reserve corps will be organized in the near future through which active cooperation with civilian chemists can be established. National guard units as well as regular army divisions will be trained in gas warfare.

Following remarks, voicing the willingness of civilian chemists, and particularly former service men, to cooperate with General Fries in every way, by Colonels Burrell, Bogert, and