of October he was assigned as Chemical Advisor and put to work coördinating the chemical information we were getting. Not satisfied with doing only two or three men's work, he proceeded to get into the field—in touch with the British, to hunt Germans in No Man's Land, and eventually to rise to be Chief Gas Officer of the Second Army and one of the best experts on chemical warfare.

There was Colonel Hildebrand, also of the University of California, who progressed so rapidly in the military application of chemical warfare problems that he was put in command of the Proving Ground and the American Army Gas School, a position he filled with the greatest credit to himself and to the United States.

Another was Major Keyes, of the Boston "Tech," who got together in the United States, transported to France, and there put up and operated one of the finest laboratories in all Europe. The work of that laboratory was small in comparison with the work done in American University, but it was vital and would have become vastly more so had the war continued another year. The emergency problems in the field—such as the determination of when the chemicals in the canisters were destroyed, and the opening and determining of the contents of new gas shells—were problems looming bigger and bigger all the time.

Then there was Major Pope, a chemical engineer, whose report on the impossibility of our manufacturing gases in France was timely, correct, and vital. Up to that time certain persons contended that Americans must manufacture their gas in France and must fill their shells there. His lucid report on the impossibility of doing that work stopped all such talk and kept the United States from embarking on an impossibility.

There were many others in the field and in the laboratory or on the proving ground who did all that man could do in their positions and thus contributed powerfully to winning the war. Among them I want to mention just one more name—that of Captain J. E. Mills, of the First Gas Regiment. Joining that regiment in the United States, he was among the first to reach France. Given many opportunities to go into the laboratory or on duty at headquarters, he always begged to stay with the regiment. He stayed there even to his own detriment, so far as promotion was concerned.

He was one of the mainstays of Colonel Atkisson in all his work, giving his entire strength and very nearly his life to the cause. In his loyalty to the regiment regardless of danger and hardships when even more important work under pleasanter conditions was offered him, he typified the best in American manhood. All honor to him and to the unsung thousands like him who suffered and risked all that "Liberty might not perish from the earth."

FUTURE OF CHEMICAL WARFARE

The future of chemical warfare has been pretty well indicated by what has been here said in regard to its use in the past war and its possibilities as the Chemical Warfare Service sees it. Gas is too deadly, too dangerous, too easy to develop and produce in secret for any nation to afford to give it up.

There have been many stories of super-gases invented in America or elsewhere, that even in small quantities would wipe out whole armies. No such gas was produced in the war. No such gas will be produced. A gas may be discovered that will penetrate existing masks, and unless mask development be such as to stop the gas, the result will be disastrous to the army encountering it. It is the business of the Gas Defense side of chemical warfare to prevent just such conditions. It met and solved all such problems in the past war, and I have no doubt that it will meet and solve such problems in the future. If it can't, we are lost—lost, because, while I have the greatest faith in human nature, I would not risk the lust for power and wealth that the future United States might engender in other peoples if the latter felt they had a substance that could wipe out our Armies as fast as they approached. That all the world is feeling this way about chemical warfare is indicated by the following quotations. The first one is from a statement of the Under-Secretary of War for England, when appealing to Parliament for funds to carry on chemical warfare. He said, in part:

So long as there is any danger of other nations continuing these methods of warfare, research and experiment in chemical warfare must be pursued. Research must not only be directed towards the gases and apparatus likely to be employed in the future, but also towards protection against all possible gases. Training in the use of gas will be confined to appropriate branches, but training in defensive measures will include the whole army.

We must continue our studies of what is known as chemical warfare. No nation has renounced the use of poison gases as the result of the Peace Conference. There are nations whose word we could not respect if they did renounce it. It is essential to study the offensive side of the chemical warfare if we are to be prepared for defense. The great importance of adequate defensive appliances arises from the fact that preparations for the offensive use of gas can be made in peace-time with great secrecy, and may have far-reaching and even fatal results in the early stages of a war.

.....For these reasons it is necessary to make adequate provision for research, experiment, and design in connection with war material. It is equally necessary to avoid overlap, duplication of effort, and the setting up of military institutions for scientific research which can better be done by existing civil institutions. It is our policy to farm out to civil scientific institutions all pure research that can profitably be farmed out, and, generally speaking, to restrict military institutions to applied research and the preliminary design of apparatus.

Another quotation is taken from a statement by General Debeney, Director of the French College of War. This statement first appeared in the United States in the March 20 issue of the *Pittsburgh Dispatch*. Among other things General Debeney said:

Should war begin now, aviation, and especially gas, would play one of the most important parts. The progress of aviation would make the rear of each front, and very far in rear, extremely dangerous, and the progress of chemistry would permit the use of gas on zones of such an extent as cannot be imagined.

Making gas is naturally rapidly done, because all the manufacturies of chemical products—still so numerous in Germany—can be requisitioned, but to make airplanes is much slower.

The defense against gas seems to be more difficult than against airplanes. I believe that against airplanes, the anti-aircraft artillery is susceptible of making rapid progress, and perhaps in that very instance gas will be one of the best ways, if with appropriate shells the *air can be poisoned all around the attacking airplanes*. It would be much more effective to create, for example, a sphere of poisoned air a mile around the airplane, instead of trying to hit the machine directly with bits of the shell.

Finally, the following statement, taken from the *Des Moines Register* of March 22, 1920, probably expresses about as well as any words I have yet seen the position that I believe the average man in the United States takes regarding chemical warfare.

As to poison gas, we would as well accustom ourselves to the thought that it is now a permanent and important part of war. To get hot about that is as futile as to scold the men who invented gunpowder, and is on the same plane. It is ridiculous to declaim about the incidentals of war while ignoring the truth that war itself is the enemy. If America ever again "draws the sword," to use an expression that shows the difference between war of yesterday and war of to-day, America will go in with as much reliance on gas shells as her antagonist can possibly have. Nobody in the military councils at Washington or West Point even dreams of anything else. And if America does not add a few refinements to the use of gas it will be because American wit and ingenuity have broken down, which isn't likely.

VICTORY AND ITS RESPONSIBILITIES

By Charles H. Herty

EDITOR, JOURNAL OF INDUSTRIAL AND ENGINEERING CHEMISTRY

A half decade ago the common lament among men of our ilk was that the science we represent and its applications were not appreciated by our fellow-citizens. We had grown accustomed to and accepted as almost ineradicable the popular conception

of the chemist as a long-haired, bespectacled individual performing some mysterious magic in a carefully secluded workshop. We fretted over the grotesquely distorted reportorial accounts in the press of any matter pertaining to chemistry and our eyes looked in vain for intelligent and sympathetic discussion of the chemist's work on the editorial pages of the American press. Salaries were inordinately low and the general atmosphere surrounding the profession was such as to repel rather than attract the students in our universities.

To-day that state of affairs no longer exists, the American chemist has come into his own. Chemistry is on the lips of everyone, the real personality of the chemist is understood and his work is appreciated at its true value. A victory has been won—a victory over public opinion. What are the evidences of that victory?

In the offices of the SOCIETY's News Service are thousands of newspaper clippings, the number mounting daily, from every section of the country. The clippings from the news columns show reasonably scientific accuracy, combined with an approved popular style of presentation which makes them readable for the masses of our people, while those from the editorial pages show a sound and far-sighted grasp of matters chemical.

In the bookshops there are large sales of popular books on chemistry. Men like Ellwood Hendrick and Edward Slosson have made splendid contributions. In the Senate gallery lately I happened to be sitting in the section just above the desk of Senator Knox of Pennsylvania. During the "morning hour" while a multitude of minor measures were being considered, I observed the Senator deeply engrossed in reading a book. What book do you suppose it was? Not a work on international law, as might have been expected—no, it was Dr. Slosson's book, "Creative Chemistry," and the Senator was so delighted that he needs must share his pleasure, so he took the book to Senator McNary, evidently with a warm recommendation, for the Senator from Oregon immediately wrote a memorandum of the title and the publisher. Could that have happened five years ago?

Another evidence is the matter of salaries paid young chemists. The head of one of the greatest research laboratories of the country told me just a few days ago that two years ago men just graduated from colleges with the Bachelor's Degree were paid $18 per week. In that same laboratory they are now paid $34.

Five years ago but little was heard of industrial chemical research. Now the number of laboratories devoted to such work is legion and constantly increasing. Empiricism in industry is steadily giving way to scientific control and development.

But undoubtedly the strongest evidence of victory won is the sympathetic attitude of the present Congress toward all measures affecting the chemist and his work. I am a thorough believer in the idea that our Congress is truly representative of our people and its present friendly disposition has its roots in a similar feeling on the part of the "folks at home."

Five measures affect favorably our work one of which is now a law; the other four have been passed by the House of Representatives and are now before the Senate, three with favorable reports from Senate Committees and one doubtless soon to receive an equally favorable report.

That measure which is now a law is the National Prohibition Act. In view of the past uniform policy of including a visit to a brewery in the list of plant excursions at our General Meetings some of you may be taking exception to the mention of this act as one affecting favorably the work of the chemist. In explanation, however, let me ask how many of you are aware of the wording of the title of this act? Here it is: "An act to prohibit intoxicating beverages, and to regulate the manufacture, production, use and sale of high-proof spirits for other than beverage purposes, and to insure an ample supply of alcohol and promote its use in scientific research and in the development of fuel, dye and other lawful industries." That title is the mandate of Congress to the Bureau of Internal Revenue in framing its rules and regulations for the carrying out of the act. And the Bureau has faithfully carried out the expressed purpose of Congress. Both the Congress and the Internal Revenue Bureau have leaned toward the chemical industries in the drafting of the law and in the administrative procedure thereunder. Tax-free "alcohol may be withdrawn * * * for the use of any scientific university or college of learning, any laboratory for use exclusively in scientific research, or for use in any hospital or sanatorium." Pharmaceutical and medicinal manufacturers have been aided by a modification of the act of 1906 which defined tax-free denatured alcohol to be such as "destroys its character as a beverage and renders it unfit for liquid medicinal purposes." The present act requires only that the denaturing "render the alcohol or any compound in which it is authorized to be used unfit for use as an intoxicating beverage." Previously certain formulas for denaturing were set up by the Government and the manufacturer had to utilize whichever of these most nearly suited his needs. Now, however, if a manufacturer finds no suitable formula for denaturing he can demand such from the Government. Surely chemists have abundant grounds to be thankful that Congress in drafting this legislation which gave the knock-out blow to alcohol as a beverage nevertheless kept clearly and sympathetically in mind the importance of alcohol as a chemical reagent. A copy of Regulation No. 61 of the Bureau of Internal Revenue of the Treasury Department should be on the desk of every chemist.

Then there is the Longworth Bill for the safeguarding of our coal-tar chemical industry. You are familiar with its details and you thoroughly understand the character and the source of the opposition it has met. I shall never forget the look of consternation on the faces of two of the leaders of the German dye industry last October when during a conference there was brought into the room a copy of the *Frankforter Nachrichten* containing the announcement that the Longworth Bill had passed the House of Representatives. That news told them clearly that the American people were determined to make themselves forever independent of any foreign nation for such supplies, and it required no superhuman effort for them to guess which particular nation was in mind. Their gloom, however, was somewhat lightened when I explained to them that the bill had still to pass the Senate. Will it pass that body? I have always believed so, and in confirmation of that belief let me read to you an extract from a telegram I received from Senator Watson, in charge of the bill, just before leaving New York:

> I earnestly hope for the passage of the dyestuffs bill as reported from the committee. A widespread propaganda is being engaged in by opponents but I feel sure that the measure that passes the Senate will fully protect the American dye industry and thereby give an impetus to industrial and engineering chemistry in America.
>
> But this was not all of Senator Watson's telegram, he adds: Trust also that the bill for the protection of surgical instruments and chemical glassware will soon become a law in order to stimulate an additional interest in these subjects in the minds of the American youth, particularly those who attend our colleges. I assure you I am doing everything in my power to secure the enactment of these measures.
>
> (Signed) JAS. E. WATSON

Plainly the Senator is in complete accord with the Council of this SOCIETY which voted in favor of the repeal of the duty-free importation clause and which unanimously recognized in this privilege a most dangerous channel for insidious propaganda among those who some day will constitute the chemical personnel of this country. The Bacharach Bill has a deep significance for chemistry.

Another measure affecting directly the work of the chemist is the Nolan Bill, which seeks to strengthen the forces and increase the activities of the Patent Office. For years it was impossible to arouse public interest in this matter, but a few weeks ago a public hearing was held on this bill. The result was its speedy appearance on the House calendar with a favorable committee report. Its passage by the House with only one dissenting vote is a fitting example of the cordial attitude of the Congress.

Of deepest importance, however, is the feeling in Congress toward the Chemical Warfare Service. In the face of the minimizing efforts of those highest in authority in the War Department, the House of Representatives has already voted that this Service shall be an independent unit in the new army. The bill is now being debated in the Senate, and the Senate Committee on Military Affairs has taken an even stronger attitude in behalf of the Service than did the House. Just three days ago I received the following telegram from Senator James W. Wadsworth, Jr., chairman of the Senate Committee on Military Affairs.

You know, of course, that the Army Reorganization Bill already passed by the House of Representatives provides for the maintenance of a separate Chemical Warfare Service in the War Department. The Senate Bill now under discussion in the Senate also provides for a separate Chemical Warfare Service. The Senate Committee on Military Affairs was thoroughly convinced that the Chemical Warfare Service was of such vast importance that it should be allowed to develop its possibilities under its own officers and with the invaluable assistance of the chemists of the country rather than be merged in some other service of the Army in which it would inevitably occupy a secondary position out of all proportion to its real importance. In view of the action of the House of Representatives and similar action by the Senate Committee it is fair to assume that the legislation when finally completed will provide for a separate Chemical Warfare Service.

(Signed) JAMES W. WADSWORTH, JR.

The future of the Chemical Warfare Service is assured. Let us in turn respond to this action of the Congress and give to that Service that loyal support which will insure America's leading the world in chemical warfare.

There is only one regret in this situation, the removal of Major General Sibert from the head command of the Chemical Warfare Service. This action by the authorities of the War Department was a distinct shock to the country. As an aggressive organizer of that Service, General Sibert had won the high regard and affection of the members of the Service and of civilian chemists. He had been unwilling to avail himself of the privilege of retirement at will, granted by Congress in appreciation of his work on the Panama Canal, and had determined to remain on active duty until the future of the Chemical Warfare Service was fully assured in the reorganization of the Army by Congress. From the outset he advocated fearlessly and convincingly the continuation of the Service as an independent unit of the Army, and his views prevailed, though they were in marked opposition to his superiors in the War Department. And he paid the price, and was removed from the head of the Service. Now comes the news of his voluntary retirement. A man who played so conspicuous a part in the construction of the Panama Canal, and who assured to this country the future of the Chemical Warfare Service can well afford to rest upon his laurels. He will carry with him always the best of good wishes from the chemists of America.

It was fortunate that the only logical successor of General Sibert was Lt. Col. Amos A. Fries, whose work as head of this Service with the American Expeditionary Force had demonstrated his fine ability and proved him thoroughly equipped for this important position.

With such evidences of victory over public opinion before us, the question naturally arises: How has this been accomplished? It is needless to say that war activities in the past few years have brought the chemist to the attention of our entire people. Upon the successful outcome of investigations and their translation into large-scale production depended the lives of our soldiers and the task was worthily met. Then, too, the revelation in the early days of the war of our economic dependence in the matter of dyes and medicinals, of chemical glassware, of optical glass, chemical porcelain, and of scientific instruments cut deep into the very life of many of our most important industries. Dependence does not belong to the American make-up, and the speed with which this dependence was removed both as to quality and quantity of output made a story of amazing wonder. But it was necessary that that story be told and told in language that could be understood in order that the work should receive due recognition. Here it is that the chemist has worked a revolution within himself.

There was a time when the chemist felt that it was no business of his that interpretation of his work should be given in everyday language. His concern was with the day's work in the laboratory and there his responsibilities ended. So, too, he felt that as an organized group he was not called upon to express an opinion on matters of chemical economics. I remember well at the Council Meeting in Seattle in 1915 when the suggestion was made that this SOCIETY should urge legislation which would insure a domestic dye industry there was so much opposition to the SOCIETY'S so expressing itself, on the ground that it was an economic rather than a chemical question, that the matter was laid over until the following day. Fortunately the tide turned at that time and vigorous resolutions were passed which marked the beginning of the fight for an American industry.

Since that day this matter of interpretation of chemistry to the public has gone forward by leaps and bounds. Believing that we ourselves were responsible for the neglect on the part of the daily press, prominent chemists made up their minds to meet the press half way, and by their personal efforts furnish material which reporters could make into attractive stories for their papers. This material was greedily accepted by the press. Still there was a lack and this was filled by securing the services of an experienced newspaper man, Mr. John Walker Harrington, who worked daily with the chemist in this matter of interpretation. The officers of the SOCIETY realized that the question of public education as to the real meaning of chemistry to the nation was essentially a function of this SOCIETY. Funds have been appropriated in steadily increasing amounts as the work has progressed. The details of the operation of this News Service have been eagerly sought by representative organizations here and in other lands. The success of the work is due solely to the one fundamental thought that we have striven to promote nothing but the welfare of our country through a better comprehension of chemistry. In an autocracy such as Germany was, chemistry was fostered by its ruler. In a democracy such as America is, we are seeking to foster chemistry through popular education and upon this sure foundation it will last.

Another form of public education which is developing is that of public addresses by chemists to non-technical audiences. I was deeply interested a few weeks ago in reading in a New York paper a lengthy account of an address by our former President, Dr. Julius Stieglitz, before the Fashion Art League of America and the Alliance of Art and Industry on the subject of "The American Dye Industry." Those who know Dr. Stieglitz's delightful method of presentation can readily understand the pleasure and profit of his hearers, but my chief pleasure lay in the fact that Dr. Stieglitz in the midst of his busy life found time and had the disposition to make such an address. He has set an example which should be followed by each of us.

Another powerful factor in public education as to chemistry has been the National Exposition of Chemical Industries. Originating amid predictions of failure, it soon demonstrated its useful public function. In that Exposition the chemist has taken the public into his confidence and furnished the opportunity for public inspection, not only of the products of the industry but

of the crude natural resources from which and the machinery by which these products are manufactured. The character of the attendance at these annual expositions is illustrative of the widespread interest in chemistry and of the eagerness with which people will listen to the story of the chemist when it is attractively told.

What have been the results of this victory over public opinion?

Capital has been attracted to the chemical field in constantly increasing quantities. According to the statistics of the New York *Journal of Commerce* the authorized capital of new chemical, drug, and dye companies during the past five years was as follows:

1915	$ 65,565,000
1916	99,244,000
1917	146,160,000
1918	73,403,000
1919	112,173,000

while the total for the first three months of 1920 is $60,188,000. This great influx of capital has increased the demand for chemists and with this has come increased remuneration for the chemists' services. These conditions have attracted chemistry students in numbers which five years ago would have been incredible. The chief result of this victory, however, is the increased prestige which the chemist has gained. The legitimate feeling of gratification over such an outcome is not based upon complacent self-satisfaction but upon increased opportunity which is afforded for further service.

Such a victory as has been won carries with it distinct and increased responsibilities. It would be a mere platitude to say to you, fellow chemists, that this new atmosphere brings to each of us inspiring cause for even more earnest effort. What I do want to leave in your minds is that in such a sympathetic atmosphere men can work with hope and freshened zeal, in the feeling that their work is being recognized in its true significance. I need not say more about this, because I think we all grasp that point. But, gentlemen, as we work in our laboratories we must show that same spirit of originality, of fearless willingness to break into new lines, to open new paths, that characterized the spirits of our pioneer forefathers. The old fetish of a certain foreign superiority in chemical matters is gone. America's day is coming! America's day in chemistry is coming, but it is not yet here in its full realization. The one responsibility that I want to bring home to you to-day is that of carrying on still further this question of public education. It is the same story I have just been talking about. I have painted the rosy side of the picture, but there is much yet to be done. We can't be satisfied and feel that our work is thoroughly understood in this country when two such institutions as Cornell University and the Massachusetts Institute of Technology formulate plans and offer the facilities of their laboratories, their equipment and their staffs, to the War Department, and have the War Department write back: "We don't need any chemistry in this matter (referring to preparations for war)." Yet that is exactly what happened in the spring of 1917. Of course, soon afterwards they woke up, and then began a general scramble. Now is the time for education and general understanding of chemistry to be completed.

In a much more recent time than three years ago when we went into the war, even within the past six months, there has been put forward by the Secretary of War a proposal to build a great engineering school down in the woods of Virginia, a twenty million dollar institution, and send down there graduates of West Point, who have had fourteen weeks of chemistry, give them a year's training, and let them do the research work for our Army in all the problems of chemistry which pertain to warfare. You laugh, but that is to my mind one of the most suggestive of thoughts, that so intelligent a man as the Secretary should have, at the close of this war, such a hazy idea of what it takes to make a research chemist, and should seriously make that proposal. And General March says we don't need any Chemical Warfare Service, because there isn't going to be any more chemical warfare. Those are the gentlemen at the head of the War Department. I don't know whether they are educated yet. General Sibert and Colonel Fries have gone strongly the other way and put this thing right, anyway it looks now as if it is right. That is the situation to-day in spite of five years of education.

We talk about chemistry being prolific around New York City. There are hundreds of chemical industries there, and 2,000 chemists in the New York Local Section, and rafts of them over on the Jersey flats, yet when the mayor of that great city appointed his Committee on Defense and announced that he was putting on it representatives of all the interests centered in and around New York there wasn't a chemist within a mile of it. A little while later the governor of New York appointed another war committee consisting of representatives of the various industries. I went through the list carefully to find out which one of the boys was on the committee, and I am still looking for him.

With all that has been said in the papers, in the magazines, before committees of Congress, in both the Senate and the House, in spite of the fact that the President of the United States has twice selected a certain specific industry—the coal-tar chemical industry—and urged upon Congress favorable legislation in its behalf, there was introduced in Congress on the opening day of the session of last year, a bill to protect further that industry, and that bill is not yet a law!

Public opinion is not so organized, not so active in behalf of chemical matters that it will immediately spring up and react favorably upon Congress. What happened the other day when the Appropriations Committee of the House brought in a report cutting the items of the Bureau of Foreign and Domestic Commerce, cutting out the commercial attachés, and limiting the work of the Bureau? What happened? Within twenty-four hours business organizations in every section of the country were pouring telegrams and sending committees into Washington, and that appropriation went back to normal size, and passed. That is what organized sentiment can do. In marked contrast was the action of Congress in severely cutting the appropriations requested by the Bureau of Standards, whereby the splendid work of that important scientific bureau will be badly hampered in the future. Scientific men have not rallied, as did the business organizations, to the support of that bureau which contributes so much to their interests. I believe that Congress represents and desires to represent the people of this country, and yet an industry which has such tremendous ramifications and deep-seated significance to this country from so many standpoints, as testified to by men in the Army, in the Navy, in the Administration, and by workers outside of the industry itself, waits restively for the passage by the Senate of a bill which has been favorably reported by Republicans and Democrats alike with no trace of partisanship about the measure. Why has not this bill become a law? Because public opinion hasn't awakened.

One other matter—at the National Exposition of Chemical Industries there have been shown from year to year the results of the efforts of the railway companies to utilize more and more the chemist in making chemical surveys of natural resources; in other words, the chemists were doing the work of industrial agents. But right now those laboratories are closed. An officer of one of the railroad companies stated recently that he doesn't know whether they can ever get started again, that all records have been lost or destroyed, all specimens are gone. They have nothing to exhibit at this year's Exposition. When an important movement like that can be completely wiped off the boards we haven't yet taught our people fully what chemistry means to them.

Here is another thing. When the expedition was being assembled to go to Paris to represent America in the formulation of the Peace Treaty there were brought together men from nearly every line of American effort. They were going to negotiate a peace with a nation which was primarily a nation of chemists, whose work was so well known to all, for the lack of whose chemical material we had suffered in this country in the early days of the war—and yet, how were the chemists of the country represented on that mission? I don't know Mr. Summers personally. He has never been a member of the AMERICAN CHEMICAL SOCIETY. He has never been at our meetings. He has never published any articles in chemistry journals. He was first heard of down in Washington representing chemical matters on the War Industries Board. We do know him somewhat and somewhat unfavorably in connection with our platinum conservation program for munitions manufacture. Mr. MacDowell I know and am personally very fond of, but he doesn't pose as an organic chemist. He is in the fertilizer business, but he isn't a chemist and doesn't profess to be. As days went along, in came Mr. Baruch. He's been a lot of things, but I never heard him called a chemist. I wrote a little squib once in the JOURNAL, about a new use for the ultramicroscope: to find among the members of the Peace Commission someone who knew anything about chemistry. With the exception of Alonzo E. Taylor, a food chemist, I stick to that statement. If public education as to chemistry had been further advanced such a situation could not have arisen.

Our work affects the national security. It is up to us to make sacrifices, to answer the call of that man right there, the Chief of the Chemical Warfare Service, Colonel Fries, whom we hope soon to call again General Fries, it is up to us to meet him quick with the best we've got. It isn't his work, it's America's work, and the chemists of America must meet that responsibility in every way. I want to quote the words of one of the most prominent industrial dye chemists in Germany, a remark made to a group of members of the Inter-Allied Commission which visited Germany soon after the armistice. Some of you met him over here at the Eighth International Congress, Dr. Duisberg. Speaking about the Peace Commissioners in Paris, he said in words to this effect: "They are going to make a hard treaty for us. We have got to accept it. You beat us on production in this war, but we are going to beat you on production in the next war." "In the next war"—that is our responsibility to this country.

And then remember this. Before the Ways and Means Committee in Washington last spring Mr. Francis P. Garvan, the Alien Property Custodian, was testifying in behalf of the American dye industry. It was just a few days after the first dirigible came to this country from the other side. Mr. Garvan drew a graphic picture of what might be expected within a few years, outlining the possibility of a type of enemy dirigible carrying poisonous gases, flying across the ocean, and wiping out the city of New York in a few minutes. Some said he was overstating the danger. And yet Colonel Wm. N. Hensley, Jr., of the Air Service, gave out only the other day a statement made public by the War Department regarding the scheduled plan of the Germans for Thanksgiving Day, 1918. I'll read it:

* * * the German effort was scheduled to take place about Thanksgiving Day, 1918, and that the L-72, which he described as the "largest airship in the world," was expressly constructed for the raid, measuring 775 feet from tip to tip and equipped with six engines of 260 horsepower each. The L-72 was capable of carrying five tons of high explosives and incendiary material.

Action for every hour and minute of the trip was foreseen. Every possible contingency of weather, fuel exhaustion, damage to ship or machinery failure had been reckoned. Weather charts of the Atlantic were gathered, files of the German Admiralty were combed and the records of the merchant marine were searched.

That was on the schedule for the latter part of November 1918, fortunately just two weeks after the armistice was signed. Mr. Garvan spoke of a possibility, but it has now been disclosed that it was a positive intent scheduled in every detail. The Germans had already planned for this conquest.

Now I want to say a word to you about this same gentleman, Mr. Francis P. Garvan. I think he is the strongest ally that the chemists of this country have. It has been my good fortune in an unofficial capacity to be associated with him for the last three years while he was Assistant Alien Property Custodian, and later Alien Property Custodian, in working out the ramifications of this German network of intrigue, and as president of the Chemical Foundation, in straightening out this patent tangle which has troubled us so much. I received this telegram from him last night:

Please convey to the members of the AMERICAN CHEMICAL SOCIETY my sincere appreciation of the great work performed by them in the recent war. This war was essentially a chemists' war and the initiative, energy, and self-sacrifice on the part of the chemists of this country was, I feel sure, more than any other one thing responsible for the success of America. As a result of this victory the responsibilities of the American chemists have become increasingly greater. We now look to them to make America the leader of this industry in the world. We expect them to excel all other countries in the development of explosives, gases, and the other things necessary in warfare. We expect them to lead the world in the development in industrial chemistry so that the commercial supremacy of our country can be assured. We expect them to excel the Germans in the manufacture of dyestuffs so that never again will America have to depend upon Germany or any other country for these most important products. A great responsibility rests upon the chemists of this country. Long and patient research work and the building of more plants will be necessary so that the American chemists can fulfill the obligations which now rest upon them, responsibilities of our victory in the recent war. The American people are alive to and sympathetic with the work of the chemists of this country. I for one believe that within a very short period America will lead the world in chemical research work. We are only a short way from that goal now. I want to see America the greatest chemical and dyestuff country in the world and I know that every member of your SOCIETY does too.

(Signed) FRANCIS P. GARVAN

Now, gentlemen, I want to read finally one extract in further introduction to you of the personality of Mr. Garvan. It is the conclusion of his testimony before the Senate Finance Committee. I do this because there is a thought in it which to my mind is one of the most inspiring which has been brought forward by a public man, at least as affecting our work.

Gentlemen, Dr. Albert and Bernstorff reported to their government that America could never establish the dye and pharmaceutical industry in this country, as we lacked the moral power for the creation of such an industry; that her each party pursued its own selfish interests, but nobody kept the whole in mind; that this problem could only be solved through regard for all points of view, and that the conflicting selfishness of this country rendered that solution impossible. Wrong; wrong; as ever, wrong! Let them await the answer of American patriotism, American sacrifice, and American ability.

We felt that we would like to be a part in the taking of the forces of science developed by them—which they have only turned to the desolation and destruction of mankind—and placing them in the hands of what we believe to be a higher and purer civilization, to see if we cannot, out of the terrible mess of this war, do something constructive with these same scientific forces, do something to direct them into the channels of alleviation and helpfulness to humanity. It is only to give American principles and character a chance that we ask you to hold these people off until we get our education. Then we can meet them without any tariff.

To my mind that puts the goal before us. That elevates our work far above mere commercialism. What in the world does it mean to make dyes, to make sulfuric acid, to make caustic soda? We need them, they are a part of our civilization, and the men who are in the industry are entitled to a just return, but, my fellow chemists, there is a higher mission ahead of us. It is

foreseen in Mr. Garvan's statement, though he is not a chemist. These other things must of course be done and done well, but, oh, my friends, the chemistry of the body is too little known. Think about the fact that the body is a mass of chemical reactions, which when normal mean life, and health, and happiness, but when abnormal signify disease and misery and unhappiness. Yet these are simply chemical changes. This country is spending millions of dollars for drugs on the bare chance that they may happen to be the right thing. We must get these matters on a scientific basis. We must get deeper into the knowledge of how these drugs act. It will take time, and a tremendous amount of research, but surely the goal of American chemists is a noble one, if it can start toward the attainment of the alleviation of the suffering of America. What lies beyond that we do not know, perhaps a prolongation of the average life of mankind, perhaps more happiness through life. There is something deeper in our work than mere commercialism. I am talking about industrial chemistry now, too. I don't know exactly what it is. I can't yet get my thoughts clear about it, but down in my heart I believe that when our people thoroughly understand what we are trying to do, and are thoroughly sympathetic with our aims and aspirations, when full opportunity is given for the highest energy and effort of American chemists, somewhere in that science to which we devote our lives will be found that which is uplifting to life in every way.

COLLOID SYMPOSIUM

SOME PRACTICAL APPLICATIONS OF COLLOIDAL CHEMISTRY

By Jerome Alexander

RIDGEFIELD, CONNECTICUT

"COLLOIDAL" FUEL

What promises to be one of the most far-reaching advances made under the stress of the recent war, when necessity literally was the mother of invention, is the discovery that by means of a suitable "fixateur" or peptizing agent and suitable treatment, very large percentages of cheap tars and finely powdered coal waste may be dispersed in fuel oil with a sufficient degree of permanence to enable the mixture to be stored, piped, atomized, and burned practically like fuel oil itself. Since this new composite fuel will at one stroke relieve the drain on the earth's rapidly diminishing stores of petroleum, as well as lead to the efficient utilization of all kinds of coal waste (culm, screenings, dust), inferior fuels (peat, lignite), and even cellulose waste (slabs, sawdust), it may be hailed as a powerful factor in the conservation of our natural resources and a lasting benefit to mankind.

Realizing the vital importance of the Allies' oil supply in the conduct of naval, military, and manufacturing operations, the German submarines bent every effort to destroy tankers; and Marshal Foch is said to have cabled America: "If you don't keep up your petroleum service, we shall lose the war." While the Allies' navies were dealing with this peril in a most decisive fashion, Lindon W. Bates, head of the Engineering Committee of the Submarine Defense Association, with the assistance in laboratory matters of Dr. S. E. Sheppard and other chemists of the Eastman Kodak Laboratory, courteously opened to him, developed a colloidal fuel, which, by practically doubling the usefulness of every oil cargo, would have of itself materially assisted the defeat of the Hun efforts.

Coal or other combustible solid is prepared for dispersion by being pulverized so that about 95 per cent passes through a 100-mesh, and 85 per cent through a 200-mesh screen. This of course means that by far the greatest weight is in particles hundreds and thousands of times larger than colloidal dimensions. But we should remember that the violent motion of the colloidal particles causes the Brownian movement of much larger particles, as is the case in milk where the fat globules can be seen in the ultramicroscope oscillating about under the ceaseless bombardment of the casein ultramicrons. It has been found that a fluid fuel may be made containing as much as 40 per cent by weight of powdered coal, and mobile pastes containing up to about 75 per cent; and mobile gels may be made both from the liquid and the pastes.

The exact nature of the fixateur is withheld pending the issuance of patents here or abroad, but it is stated that ordinarily between 0.5 and 1.5 per cent of the essential component of the fixateur is used, whereas about 0.1 per cent exercises a noticeable influence. The amount is determined by the nature of the mixture, the components, and the degree of permanence desired. The bulk of the particles does not begin to settle until the period of "life" has passed, the colloidal fuel having a limited "life" which may be regulated to meet requirements—days for power plants, weeks and months for ocean-going vessels and central storage stations. Heat and agitation revivify the liquid fuel, and the paste form may be kept for years.

Being heavier than oil or even water, colloidal fuel compresses in a unit volume the maximum thermal value, thus economizing storage space; and it may be stored under and extinguished by water, thus avoiding evaporation, deterioration, and fire risk. Its operative efficiency is high, for when sprayed into the hot fire box the oil-permeated particles of carbonaceous matter are still further atomized by the sudden gasification of their imbibed oil. It possesses the advantages of fuel oil over coal—absence of smoke, dust, and ash, practical elimination of labor in loading into storage space and in firing, with resultant saving in time for "coaling" and for raising steam. As with oil, a protective smoke screen may readily be produced by over-firing, and the fire is subject to instant control.

SMOKES

While it is an ancient principle of strategy to attack an enemy under cover of natural fog or mist, the recent war resulted in an enormous development of artificial smokes as aids to naval and military offensive and defensive operations. Like the cuttlefish, steamers strove to escape pursuing submarines in colloidal clouds of their own making, and soldiers crept to the attack under the protection of a smoke barrage. In the air, nature's own clouds were favorite hiding places for aëroplanes and dirigibles, and the latter (especially Zeppelins) often produced their own concealing clouds.

In times of peace the treatment of smokes and fumes is mostly confined to their coagulation by the Cottrell process, by which sulfuric acid mist or zinc oxide fumes have been collected as part of the ordinary course of operations, and by which injurious industrial dusts, *i. e.*, smelter and cement fumes, have been converted into sources of profit. There is, however, one case of the commercial production and utilization of smoke that possesses features of interest—the use of the so-called "smudge-pot."

Smudge-pots are burned in orchards, especially in spring or early summer, when weather conditions indicate that the tender blossoms or fruit are apt to be injured by frost. The heat emitted by the pots is apparently a small factor, their efficacy being due to the dense clouds of smoke evolved by the burning smudge oil. This remedy is of course useless in very cold weather, and serves only to prevent what agriculturists term a light frost, which has for its precursors a still, clear atmosphere, and a temperature approximating the freezing point. No frost of this kind occurs on cloudy or windy nights.

The freezing process, in the absence of smoke, seems to proceed as follows: as the temperature drops, moisture deposits like dew upon leaves, fruit, buds, and other surfaces furnishing nuclei, and congeals into ice crystals or "frost," when the slight heat thus set free by condensation is dissipated into the surrounding cold atmosphere, the freezing being also facilitated by the evapora-