THE AWARD AND ACCEPTANCE OF THE CHEMICAL INDUSTRY MEDAL

1948

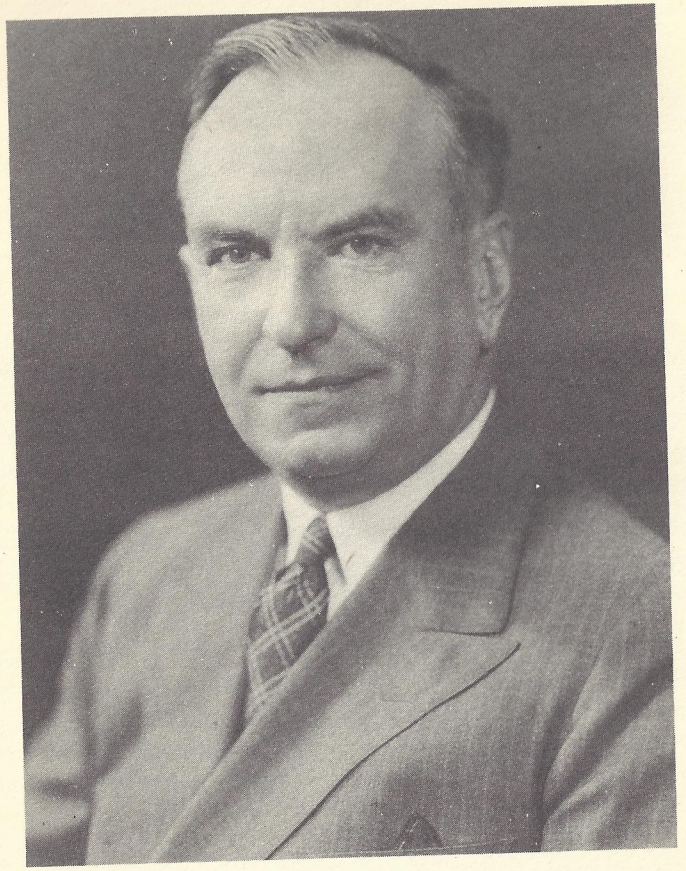
The Chemical Industry Medal was established in 1933 by the American Section of the Society of Chemical Industry. It is awarded annually to the individual who, in the opinion of the officers and directors, has given conspicuous service to applied chemistry.

The Medal for 1948 was presented by the Society to James A. Rafferty, Vice-President, Director, and Member of the Executive Committee of Union Carbide and Carbon Corporation.

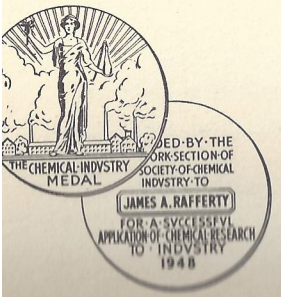
The inspirational character of the address of Mr. Rafferty on "Chemical Industry of Yesterday and of Tomorrow" has prompted requests from several sources that the Society make the material available for wide distribution in a permanent form. We have accordingly reprinted the address in full in this convenient booklet, for general distribution.

It is our belief that the substance of this address will serve to stimulate young men and women toward undertaking the future aims of industrial progress outlined by the medalist. In addition, it is hoped that this account of research achievement will also serve to emphasize the value of opportunities for the individual in a social system based on free enterprise.

Archie J. Weith,
Chairman, American Section,
Society of Chemical Industry



James A. Rafferty



1948 MEDALIST—*Vice-President, Director, Member of the Executive Committee, and Chairman of the Research Committee of Union Carbide and Carbon Corporation.*

CHEMICAL INDUSTRY OF YESTERDAY AND OF TOMORROW

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I FEEL INDEBTED to your Society for asking me to be your speaker on this occasion, as it has given me the opportunity to review my experiences in the chemical industry in a way that I might not otherwise have done. As I see it now, my entire active career has been spent in one or another of its divisions, although in my earlier years (with The Peoples Gas Light and Coke Company of Chicago*) I would have been much surprised had I been told that I was then participating in the chemical industry.

A Gas House Process That Went to College

The manufacture of carburetted water gas is not considered strictly a part of industrial chemistry, even today, although it involves chemical reactions and techniques which are in the forefront of modern engineering progress in the chemical field. The pyrolysis of natural hydrocarbons is a part of this gas making process and many years elapsed before I realized that, with slight modifications, it could be the basis of a synthetic chemical industry. The water gas reaction which was our stock in trade has since gone to college and has reappeared as the synthetic ammonia process, the methanol process, the basis of the production of synthetic motor fuels and still other promising, but less well developed syntheses.

I must admit that I did not learn this modern and significant chemistry at that stage. I can, however, thank my gas house experience for a knowledge of some of the factors which are today important in making the chemical industry a faithful servant and a leading factor in our current civilization. I found that chemical reactions and mechanical equipment, alone, do not constitute an industry.

*Soon after graduating in 1908 from the Lewis Institute of Technology in Chicago, with a degree of Mechanical Engineering, Mr. Rafferty became Chief Chemist, and later Superintendent of Distribution of The Peoples Gas Light and Coke Company of Chicago. Mr. Rafferty received, in 1944 an honorary degree of Doctor of Engineering from the Illinois Institute of Technology.

Of greater importance than these is manpower—enthusiastic, well directed. Too much trouble has occurred in industry since that time due to overlooking this elementary principle. The chemical industry has always created great values and, if properly directed, there should be ample reward for all concerned, not only the workers and owners, but, most of all, the general public in the form of better goods and lower prices.

I learned, too, that there must be the principle of service, and the gas house is one of the best places for this lesson, at least the response is quicker in case the pressure on the line gets low at dinner time. Perhaps in other branches of industry, where the response is not so prompt, managers have failed to realize that industry is favored or disfavored in proportion to the services rendered.

Recognized Bond Between Practical Men and Theorists

When I received the very attractive offer to enter the employ of The Linde Air Products Company, I was happy to associate myself with a company whose principal activity was the application to industry of an outstanding scientific discovery of the time. My technical training had given me great respect for Dr. Carl von Linde, one of the great industrial scientists of the world, and his discoveries were, in his day, not much less astounding than the atomic energy discovery of the present. I became a participant in the debate that was going on in those years, as to whether the scientist should debase his lofty profession by making practical use of it in industry, or on the other hand, whether the industrialist could afford to permit the impractical theorist to jeopardize his valued equipment and the lives of his workmen. I was indeed fortunate to have the convincing performance of the Linde Company available for observation and it took little time to convince me that science and industry have a natural bond in common. It is hard to realize that there ever was a debate of this kind and I can be thankful that my associations gave me an opportunity to see the mutual importance of science and industry at an early date.

This marriage of the Linde Company and science has been a most fruitful one. I have seen the day by day difficulties of a once hazardous industry eliminated by the constant application of science to the solution of aggravating problems. First, safety was achieved; then large volume of production; then economy. It is today's commonplace to have liquid oxygen produced by the thousands of tons and shipped about the country by tank-truck and

tank-car, as befits the low cost, essential commodity that it is. Oxygen has ceased to be solely a tool of industry as a means of obtaining high temperatures. More and more it is becoming a basic reagent of the chemical industry.

World War I Helium Project Paved the Way

An early assignment in my experience with the Linde Company was to assist in the extraction of helium from naturally occurring gas mixtures, during the first world war. This was a challenging project, involving new applications of science to industry. There was, as well, the thrill of being engaged in an adventure of doubtful probability of success on which, we were told, the outcome of the war depended. So doubtful was the promise of success that three plants were started, one by the Linde Company and two others, using competing processes. I am happy to say that the Linde process produced helium in ample quantity on the date promised and the other two plants thoroughly justified the basis for doubt. This exciting adventure lasted only a few years, but from it came experience that will continue to be of importance to the chemical industry indefinitely. It was one of the early government contracts to accomplish military objectives through private industry which, in modified form, have been so frequently used during the last period of hostilities. As an unintentional byproduct of the main purpose, it demonstrated the ease with which the Linde principles could be applied to hydrocarbon gases. The liquefaction of hydrocarbon gases had been done many times before in laboratories, but when millions of gallons of liquefied petroleum gases appeared in the course of the helium extraction, it became obvious that this was a matter of more than casual interest.

Early Experiments With Petroleum Gases

About this time there appeared an inquiry from the research laboratory of an associate company, as to the practicability of producing pure olefines from the gas mixture, resulting from the pyrolysis of just such petroleum gases. There may have been thoughts in my mind at just that time that there could be too much science in industry. However, the facts presented seemed sound, the prospects were most alluring and the spirit of the then newly born American chemical industry could not be denied.

It would have been very helpful if there had been a parallel elsewhere in industry to go by, and it was most confusing to have to explain to associates and indeed to myself just how these olefines, that were supposed to be the basis of candlepower in illuminating

gas, could be used for anything else. The really hard question to answer was what would we do with these unknown derivatives, such as, ethylene glycol or isopropyl alcohol, even if we could make them. Questions such as these perplexed my associates in New York, but on careful study, I was amazed to find that underneath such general problems there lay a mass of literally hundreds or thousands of other problems, not only unsolved but unstated.

Invested in Good Talent

Certain of my associates in research and engineering did some very capable work in experimentation with problems in chemistry and in chemical engineering design and I enjoyed observing the precision of their methods and the accuracy of their results. It came as a surprise to me, however, to realize that I was probably the greatest experimenter of them all and in fields where precise methods did not exist, and accuracy could be determined only after many years. An organization had to be created and the right men chosen for the right places. Our courageous supporters had to be convinced that this was not "Operation Rathole." The products for commercial development had to be selected, realizing that the first failure would be the last one. Among a host of other decisions that perplexed us then was whether a project, operating at a loss, could afford to pay salaries high enough to attract the best qualified technical men. I am happy to say that this decision was made in the affirmative and more than any other thing has established the character of Carbide and Carbon Chemicals Corporation.* My early days in the gas house, where I learned to know men, were not forgotten and the same policies adopted for technical men were extended to all employees long before industrial relations became a term with which to conjure. One amusing difficulty that I did not lose much time over was how to apply the bankers' ratio for percentage of profits returned to research and engineering development, in a company incurring handsome losses.

This situation extended over a period of eight years, during which operating losses became increasingly greater each year, as the scale of activity increased and, notwithstanding, morale became increasingly higher. One little thing we did at this time was to package our raw material, propane, as a bottled gas for use as domestic fuel beyond the gas mains, one might say as a hedge

*Mr. Rafferty is a former President and now Chairman of the Board of Directors of Carbide and Carbon Chemicals Corporation and Bakelite Corporation, both Units of Union Carbide and Carbon Corporation.

against the presumptive failure of the synthetic organic chemical business. It was a nice idea too, a multi-million dollar business today, but I'm glad it wasn't needed for its original purpose.

How the Ph.D.'s Invaded Sales

Long before we crossed the line into financial respectability it became evident that the remaining factor, necessary for operating success, was volume of production, required to permit sales prices that would stimulate corresponding volume consumption. It was an interesting realization that the whole success of our venture, which had worked out remarkably well so far, now lay outside of our own control; it was in the hands of the consuming public and our only contact with them was through our sales organization. I was urged to secure a practical salesman and that meant a model of the 1920's. At this point I risked my dwindling reputation with my superiors by picking a Ph.D. chemist from our research department. I was naive enough to think that there was as high a quality of scientific thinking required in the application of these new products to practical use as there was in the making of them. The results speak for themselves and today it may seem like a commonplace, hardly worth telling. This practice has continued in our organization until at the present time, it would be difficult to tell the difference between our research and sales organizations by the scientific qualification of their members.

Well, the foundations were good. The hundreds and thousands of details had been cared for. We had an organization of good men who had grown up with the job and we had the co-operation of the general public who admire synthetic organic chemistry quite as much as we do, when properly acquainted with its marvels. The years since then have been busy ones, but immensely gratifying. There are many statistics which had best lie buried in the reports of the Department of Commerce. I am willing to accept the single statistic that some years ago Carbide and Carbon Chemicals Corporation became, in its own right, the second largest chemical company in the United States.

Bakelite Joins the Family

My pleasant days with the Carbide and Carbon Chemicals Corporation were interrupted by my associates who desired to bring experience gained in certain branches of the chemical industry to bear on other branches. An unusual opportunity presented itself, just prior to the second world war, to add the Bakelite Corporation to the other activities of the Union Carbide and Carbon Corpo-

ration, as a fitting complement to its industrial structure. This pioneering group had built an enviable position in, what was originally, an isolated point in the chemical industry. Its growth, as well as the growth of its neighboring industries, had brought its interests close to those of several Units of the Union Carbide and Carbon Corporation. It was a natural evolution to include it within the Carbide family, but, nevertheless, one that was not without certain inherent difficulties.

An industrial leader who understands the full details of his company's operations has a great advantage, as my previous experience has shown me. An industrial group which has personal acquaintance with and confidence in its leader can easily conduct any maneuver called for. In the situation in which I found myself these two essentials were at least temporarily lacking. It was a new experience and a most interesting one. It was a bit difficult to learn a whole new technical vocabulary and to make a whole new group of business associates. The impending war and obligations in other directions were complications, but I am indebted to the forbearance of my associates and to the constructive vision of sound technical men, wherever they may be found, to recognize that we were engaged upon a program that was advancing those principles to which all of us were devoted.

The goal in sight, which bound us together, was a common recognition that plastics have emerged from the field of trinkets and gadgets and that they are now an important engineering material of great significance. In all of chemical industry, public acceptance is an indispensable factor, but I have been impressed by the situation in plastics that the demands made upon us are today ahead of industrial accomplishment. This is a stimulating challenge and I am willing to make the assertion that this will lead to even bigger and better results through the true and tried procedure of putting more science in industry, combined with concerted effort until the job is done.

Metallurgy Does Not Stand Apart

There is a dispute of long standing as to whether chemistry and metallurgy are divisions of the same science. I wish to avoid taking part in this altercation, but I can say with pleasure that, as an industrialist, I have had the opportunity to work with both groups. Our associate unit, the Electro Metallurgical Company, is an outgrowth of the pioneering production of calcium carbide in the electric furnace. In assisting in their program of improvement and enlargement, I have been amazed at the extent and diversity of

the application of unusual techniques. I have seen the harnessing of mighty rivers to provide hydroelectric power; I have seen operations belching fire and smoke at temperatures among the highest used in industry. I have observed mining operations in remote places and have noted unusual raw materials and unique end products. Indeed, there is reason for the metallurgists to consider that they are a group apart. However, I must also state, after a careful study of their industrial practices that in principle, in purpose, in thought and in plan they coincide in every respect with those of the other branches of our great chemical industry. This conclusion has dawned upon me gradually and I believe its true interpretation is one of great significance to us all. It is that our great industry is so ramified that it is most difficult for any of us to get an overall view of its workings.

My association with the remaining large unit of our corporation, the National Carbon Company, has given me a similar impression. Here is an industry dealing with the element carbon and certain of its specialized applications. Its basic science is largely physics, although it includes certain phases of plastics and ceramics. The outstanding characteristics of its products are controlled electrical properties and resistance to chemical action. It uses characteristically unique techniques and has not considered itself a chemical industry. From my roving point of view, I cannot agree with such a classification; I consider it a full-fledged member of the chemical family and another bright jewel in its crown.

Chemical Industry's Maturity Confirmed

You, my associates in the chemical industry, must realize, as I do, the great compliment paid to us by our country when we were called upon for assistance in a time of great emergency. It was a recognition of the stature we had attained since our primitive days of World War I. Hundreds of important assignments were distributed among companies of our industry, each an indispensable link in a chain of performance, where failure at any point might have spelled disaster. A fair share of these assignments was apportioned to the groups with which I am associated. Each of them was a startling deviation from standard practice. Each of them involved ability to think independently in the rush of events and, most difficult of all, to jump from laboratory scale of operation to full scale, with no privilege to fail. Each involved a romance of bright hopes, feverish efforts, times when failure seemed imminent, but in every case, success was achieved on or before the date set.

Our Chemicals Company received the assignment to participate in the Rubber Program and designed, erected and operated plants embodying wholly new processes discovered by our research department. One of these was for the production of butadiene from alcohol and the other was for the production of styrene by an original process. Our butadiene plant was first in operation and by VJ Day the alcohol process had produced over 60% of all butadiene manufactured. Another less well publicized assignment was the production of polyethylene to make radar a practical tool under wartime conditions. The process was perfected, the plant built and in operation, before it was generally known that a critical situation had existed.

The well-recognized importance of metals in warfare made it certain that our Metallurgical Group would be called upon for major performance and this was most certainly the case. All standard lines of products were produced at rates above any theretofore known and in addition unanticipated specialties were called for on short notice. A magnesium plant using our own laboratories' process was built and operated. Stellite, known for its unusual hot hardness, was put into many applications, principal among which were ordnance and supercharger buckets.

The Linde Company was the first to be consulted for unusual uses of oxygen and collaborated with all of the services in applying oxygen where its valuable properties made it an important factor in the war effort on land, in the air, on the sea and under the sea. The National Carbon Company similarly participated in a general program which produced the spectacular V.T. fuse, its assignment being the energizer, a battery which operated under conditions such as no battery ever operated under before. Also Bakelite produced material for a frangible bullet for use in airplane target practice which served greatly to increase the accuracy of our airplane gunners.

We Embarked On the Transmutation of Elements

This was a yeoman's portion, but, with the early lesson of the helium plant in mind, it was possible to crowd these extra assignments into the schedule already congested with overcapacity production. Over and above all this there were mysterious inquiries regarding which no information could be given, first in one Unit of the Corporation and then in another. Finally it became evident that the natural position of our Corporation had put us in the midst of a government project of enormous significance and soon we were able to discuss that portion with which we were concerned with high authorities. It was a startling realization. The alchemist's dream come true. We were asked to embark on the transmutation of elements with no forewarning; with billions of dollars to spend and the safety of civilization at stake. Here was confusion piled on confusion. Our technical assets were impressive, but how and to what extent should each be fitted into an unknown pattern?

I can thank years of experience in the application of science to industry and a magnificent technical organization for gradually getting order established and providing a program broken down into segments, each capable of being handled within the manpower and technical limitations imposed upon us. Our Metals Group had a very definite part to play in the exploration for and in the production, concentration and refining of uranium ores. Our National Carbon Company had huge facilities for the production of graphite of special grade. The Linde Company improvised new facilities for special purification steps and for technical assemblies previously unheard of. The Bakelite Corporation adapted plastics to bridge a gap in our techniques. While synthetic organic chemistry has little to do with atomic energy, the Carbide and Carbon Chemicals Corporation carried the heaviest load of all. Its engineering design group and its experienced operating personnel hurried into existence and put into successful operation the huge Oak Ridge plant, known as K25. Since then it has also taken over the management of all of the operating and laboratory units at Oak Ridge.

I can sigh with relief that the confusion and uncertainty of those days are past. Also I can take pride that the true and tried principles which have built our chemical industry did not fail in the crucial test. We can also be proud that in this fateful emergency it was the chemical industry which was called upon to meet the situation that was delivered at its door by the physicists. What use will eventually be made of this enormous gift of science and industry is beyond my ability to predict. I can feel no compunctions in having, in some way, added to our store of knowledge and to the energy reservoirs available to mankind. In case it should some day be abused, I feel sure it will be due to a human failure which would have caused destruction, in any event, by whatever means available and not because of this great achievement.

Chemical Industry and the Future

Since I have been fortunate in being able to participate personally in the inception and subsequent development of several significant projects in the field of chemical industry, the thought has

recurred to me many times, what does the future hold for this relatively new activity of civilized man. The advance in one lifetime has been so great and the acceleration in recent years has been so rapid that we can be sure that it is a movement which is gaining momentum. After several visits to Europe, during which I had an opportunity to study industries abroad and to compare them with our own, I feel sure that the well-being and national safety of peoples is in proportion to the success and extent of their industries, of which the chemical industry is an important one.

At one time I was concerned whether the public would accept the products of applied science and was pleased when I learned that they did so eagerly. I believe now that I needed not to have concern over this subject. It is evident now to all that the well-planned and well-executed products of applied science are far superior to the naturally occurring materials which were never designed for the uses to which they were adapted, in the absence of anything better. The word "synthetic" has lost its opprobrium and today intelligent chemical buyers realize that it means a material of uniformly high quality, designed for the purpose for which it is used and available at progressively lower prices, with increasing volume of consumption.

Accordingly, the chemical industry of tomorrow must feel the responsibility which accompanies the high honor it now has. Products which were once questioned as to acceptance have today won the field and the consumers are no longer willing to return to former sources of supply with their attendant economic disadvantages. Furthermore, we cannot even stand still. We have assumed major responsibilities for raising the standard of living in peace and for national defense in time of emergency. Current social movements indicate a higher living standard is to be expected throughout the world and what was once the luxury of the few is now becoming the necessity for all.

Achievements Bring Responsibility

As one who has roamed a variety of fields of the chemical industry, I have had perhaps a better chance to study the boundaries than those who have been working more intensively within one field. I can see that the necessity of utilizing the vast deposits of lower grade raw materials is widespread, as the limited deposits of high grade raw materials are being consumed. This is particularly true of metallurgy in all its branches and is dramatically illustrated by the rate of exhaustion of our high grade hematite deposit in the Mesabi. Similarly, our liquid petroleum deposits are shrinking in proportion to consumption and the chemical industry will be called upon to convert less easily treated carbonaceous deposits to make them available as motor fuel. High grade lumber is in short supply and the plastics industry must aid us, first, supplementing and eventually replacing wood for many uses. With the world food shortage and the growing population, the question arises as to whether we can long afford to use crop land for producing industrial raw materials. Such responsibilities of the chemical industry will be directed by necessity under the penalty of a falling standard of living or weakening of our national defense.

There are other possibilities which seem to me the more attractive, whereby our industry can continue its course of providing better things which are not now demanded, because they are little known. However, the germs of these ideas exist in the minds of our forward thinking scientists and industrialists and they need be no more difficult of accomplishment than the successes of the past. The construction field is one, much in the public mind today and one need not spend a great amount of time investigating this subject to find that the methods and materials were frozen long before the day of an aggressive chemical industry. To make our homes and buildings as modern as our motor cars is a huge task, but one well worth doing, and we must take the lead. The damage done by fire each year in our country is a serious loss which all must bear. As long as fortuitously occurring natural materials are used extensively, this will continue to be the case. However, the scientific basis is already laid for the large scale production of nonflammable synthetic materials to replace the flammable ones now used. The damage done by rust and corrosion is also enormous. Stainless steels have provided the first bulwark in the fight on this ravage and better, as well as less costly, corrosion resisting alloys certainly will be forthcoming. As another illustration, our agriculture is one of our less progressive industries, at least chemically. Steps are already under way to remedy certain difficulties by the use of herbicides, fungicides and insecticides on an experimental basis and this can advantageously go much further.

The Complete Man Must Be Enlisted

Then there is the ever-present human problem. I believe that this can be solved by management developing a sincere democracy of spirit that radiates mutual respect between the manager and the managed. In other words, we must try to enlist the complete man—his emotional as well as his physical and mental capacities. Our American chemical industry, thus far, has benefited tremendously from the enthusiasm of all the pioneers who have been privileged to work in the ever-stimulating atmosphere of American free

enterprise. Much good has also derived from the success of some skillful managers in selecting, training, and guiding men and women through the thrills, as well as the pitfalls, of worthwhile creative work. May our industry, as it moves into maturity, ever retain the benefit of these lessons and realize that wholehearted co-operation and high morale are keys to successful industrial growth.

I have enjoyed this opportunity to discuss with you the situation in which our great industry finds itself. Its success has brought problems requiring mature thought and consideration. The little group of fellow-workers discussing their problems after hours no longer suffices to handle problems of such magnitude. The Society of Chemical Industry serves an admirable purpose in providing a forum where such matters can be debated. I urge that all of us recognize the need for careful planning for the immensely important work of the years to come. If we preserve the spirit of courage and of intellectual honesty, which has characterized our successes thus far, we cannot fail and in doing what we can and must do, there will be rich rewards for all.

PRESENTATION

of the

CHEMICAL INDUSTRY MEDAL

to

JAMES A. RAFFERTY

The Waldorf-Astoria, New York November 5, 1948

SPEAKERS

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Archie J. Weith, *Chairman*

"JAMES A. RAFFERTY—THE MAN AND HIS WORK"
Fred H. Haggerson

"THE MEDALIST—A MAKER OF CHEMICAL HISTORY"
Williams Haynes

PRESENTATION OF
THE CHEMICAL INDUSTRY MEDAL
Cyril S. Kimball, *Past-Chairman*

ACCEPTANCE ADDRESS
"CHEMICAL INDUSTRY OF YESTERDAY
AND OF TOMORROW"
James A. Rafferty

NOTE: Transcription of the meeting was made. Those interested in procuring copies of the addresses of any of the other speakers — should communicate with the Society of Chemical Industry, Dr. R. Heggie, Secretary, 30-30 Thomson Avenue, Long Island City, New York.