SCIENCE

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CONTENTS

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THE EXPANDING RELATIONS OF CHEMISTRY IN AMERICA[1]

AFTER a year of such strenuous service as characterized that through which we have just passed, it is well that we are again assembled for report on the work of our laboratories and for helpful conference concerning future growth and broader service. A large part of the past year's work has, through the suddenness of the call, been necessarily individualistic; the assemblage of this week furnishes the means for planning more coordinated effort for mutual counsel and for deepening that spirit of cooperation which is so essential if we are to worthily meet our full responsibilities.

It is again incumbent upon me to address you. In seeking a subject I have put aside the temptation to lay before you statistics illustrative of marvelous growth during the past year, and, in spite of our belief in specialization, it has not seemed suitable to select any one line of development for tracing in thorough detail. This period is still too formative and the demands upon you too many-sided for such restricted discussion. I have therefore selected the broader topic "The Expanding Relations of Chemistry in America," using the present participle advisedly as indicative of growth and as mandatory of greater effort if the widening circles of chemical influence are to reach the broad shores of full-fledged accomplishment.

The dynamic center of this movement is

[1] Address of the President of the American Chemical Society read at the New York meeting, September 26, 1916.

the American Chemical Society, which now consists of 8,136 members, a net growth of more than one thousand during the year just ended. This splendid growth is not only a tribute to the energetic activities of our efficient secretary, but is an evidence of increased activity in chemistry and of a quickened realization of the need of the strongest possible national organization. The strength of this organization, however, is not measured so much by numbers as by the loyal and unselfish response of its members to every call made in its name. To this I can abundantly testify.

In considering the expanding relations of chemistry in America let me group these under four heads—the relations to university administrations, to the national government, to our daily needs and to national thought.

RELATIONS TO UNIVERSITY ADMINISTRATIONS

Without doubt university executives have gained during the past year a clearer conception of the fundamental value of chemistry to the nation. Aside from our own exhortations, this conception has been easy of obtainment through the increased publicity given by the daily press and by periodicals to matters chemical, through the difficulty of purchase of certain needed supplies, through the feverish activity to meet these unexpected demands, and through the call for young chemists from university laboratories. Has the conception, however, been translated by the makers of university budgets into deeds which will insure an adequate response by the universities to the increased demand which is to be made upon them for chemists possessed of the best possible training? I have neither purpose nor desire to criticize, nor even to attempt answer, but I do not hesitate to suggest that in these abnormal times the demands upon chemistry departments are unusually great and should be generously met if we are to view the future with equanimity. The bounds of the service of chemistry to the nation are prescribed by the character and extent of the training given in our universities. Physical equipment must be increased and bettered, and staffs must be maintained adequate in number to allow full opportunity for research along with teaching duties.

The stimulus of these remarkable times upon the minds of the students is plainly evident, but here lies a danger. The expansion of existing industrial plants and the creation of new lines of endeavor in chemical industry call for many young men to serve in control work, and the call is often very alluring. It would be a great misfortune if the filling of these new positions should be at the expense of the graduate students of the future. We can not afford an abridgment of the number of young men thoroughly trained in our universities in the methods of research. Graduate fellowships in largely increased number should be provided, for without such aid the door of opportunity will be closed to many whose full mental potentialities will be needed in the future.

The danger of losses from university ranks, however, is not confined to graduate students: already there are strong indications of a considerable raid by the industries upon the staffs of universities, and the question of professorial emolument is therefore not one for leisurely future consideration, but belongs to the immediate present.

To sum up the university budget for chemistry needs prompt and decided expansion.

In the matter of cooperation between universities and industries definite progress has been made. Four important matters typify this progress.

The New York Section has conducted

throughout its winter meetings a symposium on this subject, and these discussions resulted in a request of the society that a permanent committee be appointed to carry forward vigorously such cooperation.

The General Chemical Company announced the formulation of a new policy in the creation of an advisory staff of university professors.

The Massachusetts Institute of Technology announced a master's course in chemical engineering, including a school of chemical engineering practise. Through the cooperation of industrial plants a half year of systematic plant experience and training is added to the curriculum without sacrifice of thorough foundation work or training in research. In return for the privileges offered by the plants, the research facilities and the faculty of the institute will be available for the study of special problems connected with each plant.

A joint meeting of the Puget Sound Section and the Seattle Chamber of Commerce aroused great enthusiasm and resulted immediately in the creation of industrial fellowships in the University of Washington for the study of the problems of the northwest.

Such illustrations furnish proof that earnest thought is being given to this phase of cooperation and it is inspiring to note how quickly such thoughts are being translated into definite action.

RELATIONS TO THE NATIONAL GOVERNMENT

Forty-nine members of the society, representing the several states and Alaska, on appointment, responded to the request of the President of the United States that the chemical industries be mobilized under the program of the organization for industrial preparedness. Publication of the correspondence in connection with these appointments would furnish lasting testimony to the loyal and unselfish patriotism of the membership of our organization.

In response to the invitation of the National Academy of Sciences our representatives are now cooperating in the organization of the research facilities of the nation and in questions connected with the establishment of the government nitrate plant.

If we are to promptly and intelligently proceed with the development of a diversified and comprehensive chemical industry we must know the detailed character and amounts of chemical importations. The statistics now published by the government are inadequate in their itemization. The formulation of the character of the information needed is our responsibility. This is the work of the committee on government statistics, of which committee Dr. B. C. Hesse is chairman. The inauguration of the work has unfortunately but necessarily been delayed. It is now well under way, and for its full consummation I beg to urge the thoughtful aid of every member of the society, and the cooperation of each of the local sections. We have never undertaken any more important or fundamental work than this. If, as a result of this inventory, we are able to state in exact terms the specific character of the information needed by the chemical industries, in order to render this country independent of foreign sources of supply, we will then have a right to expect with confidence the sympathetic cooperation of the federal authorities.

May I, under this heading, make two suggestions to the national authorities:

First, Provision should be made in the immediate future for the storage of large quantities of government-owned toluene. With the cessation of European war orders for explosives, and with the rapid increase of by-product retort ovens for coke manufacture we will eventually have a large over-production of toluene, with conse-

quent lowering of price. The potential value of this hydrocarbon in munitions is too great to allow its sacrifice as a fuel or as an illuminant, and its storage involves no unusual difficulties. The moral effect alone of its known presence in our midst would in itself justify the investment as a preparedness measure.

Second, Modern warfare is largely dependent upon the successful work of chemists, not alone in the direct production of munitions, but, through research, in husbanding the resources of the country, and in increasing knowledge which in times of stress may be vital to the nation. In view of the now well recognized fundamental character of such work the military authorities should formulate a definite policy in regard to the chemist, whereby in times of war his services may best be applied to the advantage of his country. The lack of such a policy during the recent enlistment of the National Guard has in several cases interrupted lines of research whose successful outcome would prove much more vital to the power of the army than the presence of the individuals bearing arms. England somewhat tardily recognized that her chemists were more needed at home than at the front and therefore recalled them.

RELATIONS TO OUR DAILY NEEDS

The economic developments of the past two years have emphasized the close relation between normal daily needs and the activity of chemists, particularly through certain shortages which have brought economic distress. Among these shortages three stand out preeminent—motor fuel, potash for fertilizer and coal tar products, particularly synthetic dye-stuffs. Let me discuss the first and second of these briefly and the third somewhat more at length.

Motor Fuel.—The enormous annual increase of motors using gasoline as fuel, together with the largely increased export of this material, has resulted in greatly increased price of this product. To meet the situation chemists have naturally turned their attention to the "cracking" of the residues of crude petroleum, furnishing thus some relief. In view, however, of the uncertainty of petroleum supply such efforts can not prove the ultimate solution of the problem. With the cessation of the war further aid may be expected from the benzol recovered in the by-product coke oven plants. With this at its maximum, however, it is estimated that it would equal only ten per cent. of the motor fuel now consumed. Plainly we must look further for the permanent supply, and that seems to me to be alcohol. I am fully aware that there is nothing original in this suggestion. It is mentioned rather for the purpose of urging greater consideration of the problem by chemists, who must solve the problem, by manufacturers of motors who have such great interests at stake, and by lumbermen who, in their mill waste alone, possess the raw material from which, by processes in operation to-day, alcohol could be produced equal in volume to forty per cent. of our present gasoline consumption.

What striking advance in this line could be confidently expected if the automobile manufacturers and lumbermen of the nation would join forces with chemists in the creation of a great research laboratory where the problems of motor fuel could be vigorously attacked, not by the "green powder" method of recent notoriety, but by common sense, scientific investigation, conducted by the ablest of chemists and chemical engineers, unfettered by tradition and filled with the conviction that the day of genuine new things will never end.

Potash.—To meet our present shortage of this valuable fertilizer constituent we

have sought relief feverishly through the kelp fields of the Pacific coast, the alunite deposits of Utah, the feldspars, blast furnace and cement works waste, and have as yet obtained but slight relief. Something noteworthy may yet result from these earnest efforts, especially through the aid of the appropriation of $175,000 by congress for further investigation of kelp, but at present we seem to have adopted the general policy of waiting until the war is ended.

Let me, in this connection, remind you of the old problem, namely, the rendering available *in situ* the potash now in the fields in the form of silicates. The records of the U. S. Bureau of Soils show that the average weight of a foot acre of the sandy soil of the cotton belt is 1,750 tons, and it contains an average of .1 of 1 per cent. potash, or $1\frac{3}{4}$ tons K_2O per acre, while the clay soils average in weight 2,000 tons per foot acre, and show an average potash content of 1.68 per cent. or 33.6 tons K_2O per acre. From this material nature slowly supplies available potash for plant food through the action of the soil solution upon the potash-bearing silicates, but the process is too slow. Many lines of research are in daily progress in our laboratories whose object is the discovery of "accelerants" for certain chemical reactions. Does not the importance of this problem and its altogether normal character demand of us greater effort to find a suitable accelerant for this world wide process. The problem is easy to state, its solution has as yet proved impracticable. May we not hope that the activities of physical chemists through studies of the soil solution and its action upon the mineral constituents of the soil will ultimately be successful?

Coal Tar Dyestuffs.—It is unnecessary for me to remind you at this time of the great disturbance of our industrial life which resulted from the cessation of imports of German dyestuffs, nor of the rapid extension of the by-product coke oven whereby we are now assured of a far more than adequate supply of raw material for an American dyestuff industry sufficient for American needs. It is a pleasure to testify to the energy and resourcefulness of our dyestuff manufacturers who, in spite of competition with the munitions industry for coal tar crudes and for necessary acids and with uncertainty as to the future constantly dogging their steps, nevertheless, have notably contributed to the relief of the dyestuff famine.

It is my purpose, however, to trace, for the sake of the record, the efforts made during the past two years to obtain legislative assurance of a fair start in the upbuilding of a well-rounded permanent industry, and to point out the character of the legislation which on the last day of the present session of congress became a law of the land. It is a distressing story, humiliating to all who wish for our country freedom in every possible form. Here is the story.

Immediately after the outbreak of the war the New York Section of this society, foreseeing economic distress from possible shortage of dyestuffs, appointed a representative and politically non-partisan committee to report on the prerequisites of an adequate self-contained American dyestuff industry. The report, unanimously adopted by this the largest of our local sections, recommended congressional enactment of protective duties amounting to thirty per cent. ad valorem and $7\frac{1}{2}$ cents per pound specific on finished dyestuffs, one half these amounts on intermediates and an effective anti-dumping clause. The protective rates of this report formed the basis of the Hill bill, introduced in the house on the opening day of Congress by

Representative Ebenezer J. Hill, of Connecticut. In January, 1915, hearings were held on this bill and there was presented the unusual sight of both producers and consumers urging the Ways and Means Committee to report the bill favorably. In spite of this unanimity the report was not forthcoming. Public demand for such legislation, however, increased and finally, after a conference between leading members of the controlling party in both the Senate and the House of Representatives of a large number of producers and consumers, a form of legislation was proposed by the congressional representatives which embodied the ad valorem rates of the New York Section but reduced the specific duties by one third, such specific duties to continue in full force for a period of only five years, after which time they were to decrease twenty per cent. annually. Another feature was the proviso that if at the expiration of five years American dyestuff factories were not producing sixty per cent. of the values (note this carefully) of American consumption, the specific duties were to be immediately and completely repealed by Presidential proclamation.

In spite of the lowered specific duties this agreement, confirmed by authorized interviews from Washington, led to increased activity by many producers. It is not difficult to imagine, therefore, the amazed surprise which greeted the appearance of the dyestuff section of the general revenue bill, which, while it contained all of the above, showed one other totally unexpected feature, namely, the exclusion of indigo and alizarin and their derivatives from the benefit of the special duty of 5 cents per pound. Such an exception was fatal to the purposes of the bill. The *ad valorem* duty alone would not suffice to promote and encourage the manufacture of synthetic indigo and alizarin. No scientific or technical justification existed for discrimination against these two coal tar dyes, which constitute 29 per cent. of the values of our consumption. Furthermore, the manufacture of at least 10 per cent. of dyestuffs could not for the present be attempted in this country because of existing foreign patents. Such considerations show that the possibility of expansion of the home industry within the five-year period to 60 per cent. of the values of consumption would be precluded by the terms of the bill itself. Consequently the duration of the special duty for any dyestuff would be restricted to the initial five-year period. Evidently our lawmakers had surpassed the skill of the alchemists, in that they had demonstrated their ability to transform at least bricks into gold.

Pressed for a justification of the exclusion of indigo and alizarin, the chairman of the Ways and Means Committee made explanation on the floor of the house in a speech which by previous agreement was to conclude the debate. In this speech reference was made to the satisfactory character of the conference with the representatives of the industries; individual manufacturers were referred to as not desiring full protection for indigo and alizarin; and no justification on scientific or technical grounds was attempted. Then the dyestuff section of the bill was adopted by a party vote. Immediately briefs were filed with the subcommittee of the Senate Committee on Finance in charge of this section of the House bill. These briefs included letters and telegrams from the individuals referred to in the house debate refuting the statements made by the chairman of the Ways and Means Committee. Moreover they pointed out clearly that the exception of indigo and alizarin was not in accordance with the original conference agreement and would prove disastrous to the entire industry. The Senate subcommittee

was convinced and accordingly struck from the bill the objectionable exceptions and in addition included natural indigo and coal-tar medicinals and flavors, additions in every sense logical, and giving to the classifications of the bill a thoroughly comprehensive character.

With the appearance of the printed hearings and briefs an interesting exhibit was made by the plea of a large consumer of indigo located at Greensboro, North Carolina. Not content with the discrimination given indigo in the measure as passed by the house, he urged its complete removal to the free list. No other consumer of indigo joined in this request. The subcommittee rejected his plea.

The completed section of the revenue bill was then endorsed by the full committee and by the majority-party conference, and was adopted by the senate. In the last hours of the session the section emerged from the joint conference of the majority-party conferees from both senate and house with indigo and alizarin excluded from the special duty, and carrying along with them, as a sort of legislative by-product, medicinals and flavors. As no record is published of the proceedings of conference committees we are left to assumptions as to the influence which prevailed to give the section its final form; but in the light of the history of the legislation and the personnel of the conferees, as published in the *Congressional Record,* it is not difficult to imagine whose influence was determinative in maintaining the discriminatory feature of the original house legislation, against which united protest had been made save for the voice of one consumer. The section in this disastrous form was then adopted by both senate and house and is now the law.

Such is the answer of the present congress to the nation-wide (with one exception) call for adequate protective duties for the encouragement and upbuilding of this much needed industry. The claims of this industry, upon non-partisan legislative aid are reasonable, because of initial difficulties in manufacture and the character of the competition to be met after the war. These claims are also commanding, through the intimate connection of the industry with adequate munitions for our army and navy. Nevertheless, the measure professedly enacted for its upbuilding stands to-day stamped with the evidence either of the most specialized form of legislation for special interests; or of stupidity, as a tax placed upon the consumer without the benefit of an assured home industry; or of stubborness in maintaining a wrong position rather than admit an error in judgment. I do not believe the citizens of this nation will set the seal of their approval upon such legislation.

RELATIONS TO NATIONAL THOUGHT

In the light of the activities of the past year let us ask ourselves frankly—what is the position of chemistry to-day in the thought of the nation? No one can doubt that it occupies a much more prominent place. This is due in part to the superb response American chemists have given to the sudden call upon their resources and ingenuity, in part to the advertisement through the press of the important rôle of the German chemist in the industrial upbuilding of that nation, and to the constant repetition of the phrase that "modern war is largely a matter of chemistry and engineering."

Concrete evidence of increased appreciation of chemistry is furnished by the Second National Exposition of Chemical Industries now in progress. Its exhibitors are more than double those of last year; its exhibits show many new products, born of the exigencies of the year: its underlying thought has been broadened to include

a more systematic showing of the importance of chemistry to the wise use of natural resources; and its purposes have gained a far wider and more appreciative understanding by our people as a whole.

Again we find evidence in the recent issuance of a special chemistry edition by a prominent trade journal, *The Manufacturers Record*. The purpose of that unusual issue was not merely to emphasize the advantages of a great section of the country for the upbuilding of chemical industries, but of far greater importance it sought to vitalize the thought of the people of that section as to the fundamental character of chemistry among the factors of industrial development.

Furthermore, it must be noticeable to all that slowly but surely an educational campaign is getting under way in the daily press and in periodical literature which will eventually result in the arousal of our people to a full comprehension of the value of chemistry as a national asset.

These are simply signs of the times. We can not, however, feel that the national thought has as yet grasped in its entirety the all pervading influence of chemistry so long as Cornell University, with its strong chemistry staff, must delay the replacement of its burned laboratory through lack of funds; so long as Johns Hopkins University, the cradle of American chemical research, must undergo such struggle for the means to erect a new laboratory on the beautiful new site of that institution; so long as members of congress view chemists and chemical manufacturers as fit subjects for hard bargaining; so long as railway presidents feel that chemistry has no part in the development of the natural resources of the sections traversed by their lines; and so long as waste in any form is allowed to continue unheeded.

Further expansion of the relations of chemistry to the national thought involves—

First. Continued educational effort through the press. Plans for such are being evolved, and these plans are meeting the quickened sympathy of the leaders of the press. Each of us must cooperate in this work. As a class we are not qualified to write in popular style, and in the past we have not troubled ourselves very much about such matters; but we can furnish facts and sound opinion to those who have the work and responsibility of popular presentation, and we should stand ready, each in his own community, to share in such cooperative effort.

Second. An awakening of the financial interests of the country to the fact that the ways of chemistry are not mysterious but applied common sense which constitutes a sure guide.

Third. Continued worthiness of our own efforts. This is our direct responsibility. Thoroughness of training, untiring zeal in work, aggressive conservatism in counsel, courage in new undertakings, independence in thought, generous cooperation, constant search for truth—these must surely lead us to that vantage ground where we can best serve this our country.

Chas. H. Herty

ON THE ANALYSIS OF LIVING MATTER THROUGH ITS REACTIONS TO POISONS[1]

I am told that the chair of Section I has not been held by a pharmacologist for many years, and I wish to express the pleasure I feel in the honor that has been done me personally, and even more in the recognition vouchsafed to one of the youngest handmaidens of medicine. Pharmacology

[1] Address before the Physiological Section of the British Association for the Advancement of Science, Newcastle-on-Tyne, 1916.