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ANNUAL MEETING AMERICAN CHEMICAL SOCIETY

COUNCIL MEETING

President William H. Nichols called the Council of the Society to order at 4 P.M. on Monday, September 2, 1919, in the ballroom of the Bellevue-Stratford Hotel, Philadelphia. In a few well chosen words he outlined the high points of the Society's work, touching especially upon the mutual benefit which he felt had resulted from his visit to the local sections on the Pacific Coast.

The first order of business was the election of officers. Dr. A. B. Lamb was reëlected editor of the *Journal of the American Chemical Society;* Dr. E. J. Crane is to continue as editor of *Chemical Abstracts;* and Dr. Chas. H. Herty will edit This Journal during the coming year. The secretary, Dr. Charles L. Parsons, was retained in office, and Dr. B. C. Hesse, retiring member of the Advisory Committee on National Policy, was designated to succeed himself in that office. The present board of associate editors of the *Journal of the American Chemical Society* was reëlected, and power was delegated to the editor to fill any vacancies caused by declination of present members to serve longer. It was further voted that a committee composed of Dr. W. A. Noyes, *chairman*, the present editor, and the associate editors of that Journal examine the present procedure regarding the appointment of associate editors, with a view to improvement on the method, and report at the Spring Meeting in 1920.

On motion of Mr. H. E. Howe, secretary of the Division, the name of the Division of Industrial Chemists and Chemical Engineers was changed to Division of Industrial and Engineering Chemistry. It was pointed out that this new title was consistent with the names of other Divisions of the Society, and furthermore, brought the name into conformity with the title of This Journal.

Choice of a meeting place for the spring of 1920 fell to St. Louis, the exact date to be agreed upon later. An invitation was also received from the Washington, D. C., Section, and the determining factor was the recollection of the gracious manner in which the St. Louis Section had accepted the decision to cancel the Spring Meeting of 1917, plans for which were already well under way.

It was voted to hold the Annual Meeting for 1920 in Chicago. Invitations had been received from the Chicago, Detroit, Rochester, and Washington Sections, and were accompanied by urgent invitations from the chambers of commerce and local organizations of the cities mentioned. The decision as to whether this meeting shall be held as usual during September, or shall be postponed until the meeting of the American Association for the Advancement of Science in December, was left until the next meeting of the Council.

The Report of the Committee on the Preparation of a List of Recommended Chemical Texts for Libraries was accepted and placed on file.

A committee consisting of Drs. Charles Baskerville, F. P. Venable, Julius Stieglitz, W. D. Bancroft and M. T. Bogert was appointed to draft appropriate resolutions on the death of Lord Rayleigh, an Honorary Member of the Society.

The presentation of the following by-law covering associate membership in divisions of the Society brought out considerable discussion, but the by-law was unanimously adopted.

> No person shall become a member of any Division who is not a member of the American Chemical Society; but Divisions may have associate members not members of the American Chemical Society who shall be entitled to all the privileges of the Division, save that of voting for officers; provided that such associate members shall not be entitled to any of the other privileges of the American Chemical Society, and shall pay such dues, of not less than two dollars ($2.00) per annum, as the Division may require.

Dr. E. W. Washburn presented the report of the American delegates to the Interallied Chemical Conference in London and Brussels. The substance of his report was printed in the September issue of This Journal, page 886.

Dr. Francis C. Phillips spoke briefly of the progress of the plans of the Priestley Memorial Committee, and stated that in the near future the active work of collecting funds would be resumed.

President Nichols announced that representatives of the Army and Navy Departments had enthusiastically endorsed the proposal that the American Chemical Society furnish lecturers on certain chemical subjects closely allied with war problems, at the West Point and Annapolis Academies, and warned the members that some of their number would shortly be called upon for this purpose.

The plans of the Committee on Nomenclature, Spelling and Pronunciation were elaborated by Dr. E. J. Crane, editor of *Chemical Abstracts*, who expressed the hope that a degree of coördination might be obtained among all the scientific societies using the English language. It was moved and passed:

> That the President of the American Chemical Society invite on behalf of the Council of the Society the governing bodies of the Chemical Society (London) and the Society of Chemical Industry to appoint a committee, or committees, on Nomenclature, Spelling and Pronunciation, to coöperate with the corresponding committee of the American society in order to secure as large a measure of agreement in these fields as is practical.

The support of the Society was asked, through a letter read by one of the councilors, of the plan of one of the popular scientific journals to conduct a section devoted to the correct abstracting of scientific articles in popular language. There was extended discussion of the possible results of such a course, and the following motion was finally made a special order for the spring meeting:

> That as a general policy the Society do not lend its name to any private undertaking for profit. This will not preclude contracts with private concerns to carry out undertakings of the Society.

Later the subject was reopened, and the motion passed:

That a committee of three be appointed to study the question of possible relation between the AMERICAN CHEMICAL SOCIETY and certain scientific publications, and report to the next meeting of the Council.

The chairman appointed Dr. Allen Rogers, Mr. H. E. Howe and Dr. Charles Baskerville.

The Council expressed its disapproval of the suggestion that the SOCIETY circularize its membership in support of the Conference of National Public Works to be held by the Association of Engineers, Architects and Contractors, feeling that there was little of interest to the chemical profession in the movement.

At this stage in the proceedings a message to the chairman resulted in his declaring a recess, that the ninety-seven councilors present—we believe latecomers made an even hundred—might accept the dinner invitation extended by the Philadelphia Section. Dr. Harry F. Keller, *chairman*, and his committee proved delightful hosts.

The attention of the Council was called to features of the Army Reorganization Bill (S. 2715) now before the Senate Committee on Military Affairs, of the utmost importance to chemists (see THIS JOURNAL, September 1919, pages 814–816*h*). The Secretary pointed out that the SOCIETY was already on record as against the abolition of the Chemical Warfare Service as a separate unit of the Army, as proposed by the Secretary of War (see THIS JOURNAL, August 1919, p. 789). The importance of individual effort by the councilors in bringing to the attention of their own senators and representatives the grave danger confronting the country if the bill containing these features was allowed to pass, was brought out very strongly. A committee was appointed to draft resolutions to be presented to the President of the United States and the Congress, urging that technically trained men be given the same privileges as line officers in the organization of the War Department, which is not the case in the present bill, and reported resolutions as follows, which were unanimously adopted:

The AMERICAN CHEMICAL SOCIETY of a membership of over 13,500 American chemists to-day by its authorized representatives unanimously adopted the following:

WHEREAS, The recent war has clearly demonstrated that the advancement of science through competently directed research in military problems is indispensable to the security of the nation, and

WHEREAS, The bill recently introduced into Congress (Senate 2715) by the General Staff of the Army providing for universal military service and the reorganization of the Army is of such scope and effect as to inevitably impede the development of all technical and scientific work of the Army by placing it under the absolute control and direction of purely military officers who do not have the requisite scientific knowledge and,

WHEREAS, An organization so constituted could not function efficiently and in time of stress would prove to be an element of fatal weakness and could never hope to attract to itself those scientific and technical experts without whose aid modern warfare cannot be successfully conducted,

Now, therefore, be it resolved, That the AMERICAN CHEMICAL SOCIETY emphatically protests against this or any other bill which does not provide for commissioning staff officers in the corps and departments in which they are to serve and which does not accord to the technical man the same recognition and opportunity throughout every grade and department of the Army as are accorded to the man trained for a military career only.

The following resolutions were introduced, and adopted by the Council:

WHEREAS, The AMERICAN CHEMICAL SOCIETY is convinced that the compensation of the chemist in the national and states service, like that of the university investigator in chemistry, is far below that received in the chemical industries, and

WHEREAS, The Government cannot maintain an efficient chemical service unless it offers adequate compensation to its chemists, and

WHEREAS, Various agencies are now at work toward remedying this situation, and

WHEREAS, The Congressional Commission on Reclassification of Federal Employees is one of these agencies,

Be it therefore resolved, That the AMERICAN CHEMICAL SOCIETY hereby pledges its coöperation with Congress and with the Commission of Reclassification of Federal Employees with all other agencies with like endeavor and urges upon them the vital necessity to the welfare of this country of remedying the present situation, and

Be it further resolved, That copies of this resolution be sent to the Commission of Reclassification of Employees, the press, and be published in the *Journal of Industrial and Engineering Chemistry.*

In this connection it was voted

That the President appoint a committee of three with power, directing them to coöperate with the Commission of Reclassification of Federal Employees, and to furnish them with any available data and to take such action with the Commission and other agencies as shall be thought wise in furthering the ends set forth in the resolution.

The President appointed Drs. W. D. Bancroft, W. D. Bigelow and C. L. Parsons.

The Report of the Omnibus Committee was called, it having been a special order for this meeting, but no councilor had any instructions from his local section regarding its provisions. The work of the committee was, therefore, considered as finished.

On motion, the Council adjourned.

GENERAL MEETING

When the members and guests who filled the halls and completely obscured the registration desk in the lobby of the first floor of the Bellevue-Stratford Hotel had assembled in the spacious ballroom at the call of music, scarcely a seat was vacant, and many had chosen points of vantage in the galleries. Following the singing of the Star Spangled Banner, Dr. Harlan S. Miner, senior vice president, formally opened the Fifty-eighth Meeting of the AMERICAN CHEMICAL SOCIETY, and introduced Hon. Joseph S. McLaughlin, Director of Supplies of the City of Philadelphia, who won his audience with a fund of witty stories, and in gracious words welcomed the SOCIETY to Philadelphia, the city of Priestley and Hare, and from that day to this a center of the American chemical industry.

In responding, President Nichols expressed appreciation of the hospitable welcome the SOCIETY had received, and promised that its members would reciprocate with contributions of real scientific value to the community. He took occasion also to express his appreciation of the intelligent publicity which the newspapers were giving to the chemist and the chemical profession.

Earnest and serious attention was given to the addresses by Secretary of War Baker, and Admiral Earle, Chief of the Bureau of Ordnance, Navy Department. The Secretary was loud in his praise of the chemists' part in the war, and eloquent when it came to future plans of the great department he represented. Admiral Earle gave concrete illustrations of the problems the chemist had solved for his department. (Their addresses are printed in full in this issue.)

A motion was passed expressing the thanks of the Society to its distinguished guests, and the hope was expressed that there might be no interruption of the cordial coöperation now existing between the Army and the Navy and the Society. A hearty demonstration was accorded the motion that a vote of thanks be extended to the local committees whose arrangements for the welfare of the visiting members had been so painstaking and so thorough.

The Society in general session instructed the Secretary to send telegraphic regrets to Past President T. J. Parker and Treasurer E. G. Love, both of whom were detained by illness. (It is with sincere regret that we record that Dr. Love passed away on September 11.)

At the afternoon session of the General Meeting, five papers of general scientific and technical interest were read. Two of these by Dr. Phelps and Dr. Fischelis are printed in full in this issue. Those by Dr. Bovie and Dr. Harkins will appear in the *Journal of the American Chemical Society*, while Dr. Wheeler's address will be printed in a later issue of This Journal.

The presidential address by Dr. Nichols, most appropriately delivered in the beautiful auditorium of the Museum of the University of Pennsylvania, on Thursday evening, was received with serious attention, and Dr. Nichols' hearers felt that his offer of coöperation with the Federation of Labor in the advancement of the progress of research was epoch-making, bearing enormous possibilities for the furtherance of the economic welfare of this nation. Seated with President Nichols and Dr. Miner, the chairman of the meeting, were past presidents of the Society, Dr. Edgar F. Smith, beloved provost of the University in which we were meeting and historian of the early progress of chemistry in this country, Drs. Harvey W. Wiley, M. T. Bogert, and W. D. Bancroft.

DIVISIONAL MEETINGS

On Thursday morning the smaller rooms, all adjoining the main corridor of the first floor of the hotel, became the centers for the gatherings of the various divisions, for the reading of papers lying more strictly within the field of their particular branches of chemical science. The full program of these divisional meetings is printed on page 985 of this issue. Interest ran high in what the various readers had to offer, and until late on Friday afternoon the gatherings were well attended. The Dye Section, newly formed at the Buffalo Meeting, was obliged to post in its assigned room "Small quarters for this infant section outgrown," and moved to a decidedly larger room on the floor below, where interesting papers and lively discussions ensued. The attention of President Nichols was drawn to the report in one of the newspapers of an undercurrent of sentiment at the meeting opposing the licensing commission feature of the Longworth bill, and Dr. Nichols issued a strong statement refuting the charge, as follows:

The assertion made in New York newspapers that there is an undercurrent of opposition to the license system is entirely without foundation. The chemists of the United States are solidly aligned in favor of the importation of foreign dyes through special license until such time as the dye manufacturers of the United States will be in a position to supply all the special dyes, such as the so-called vat dyes, which may be required.

The American dye manufacturers will undoubtedly be able to meet this demand within 6 months. Meanwhile the manufacturing chemists offer no objection to the importation of such dyes as cannot immediately be furnished to the textile and other industries. It is significant that this report of any opposition to the dye licensing plan should be circulated immediately after the Council of the American Chemical Society had concluded its proceedings and there is no time until 6 months from now for it to officially adopt resolutions refuting this report. This looks very much like the workings of German propaganda, which, all though the war is over, is still as active as ever, and as insidious.

During the course of its sessions the Dye Section unanimously passed the following resolutions:

Whereas, The manufacture of dyes from coal tar distillates involves the same general processes and materials used in the manufacture of explosive and poison gases for military use,

Resolved, That the question of the importation of dyes and of intermediates from which they may be made is a military question,

Resolved, That the importation of such dyes, the bases from which dyes are made or the intermediate products produced in the manufacture of such dyes is a menace to the possible future defense of our country, for the reason that such importations foster and support in foreign countries industries which would furnish an enemy with essential munitions of war,

Resolved, That insofar as dyes or intermediates or coal tar distillates are allowed to be imported in time of peace, such importations prevent or discourage the establishment, development and maintenance of an industry that is essential to national defense in time of war,

Resolved, That a copy of these resolutions be submitted at once to the Advisory Committee of the American Chemical Society for such action as in its judgment the circumstances merit, with the suggestion that copies be sent to the President of the United States and the chairmen of appropriate committees of the Congress.

....

Whereas, The American armies were factors in the victorious completion of the Great War *vs.* Germany, and

Whereas, The allied governments are placing corps of skilled chemists to oversee operations in the dyestuff plants in the occupied areas of Germany, and

Whereas, The American dyestuff industry is very much in need of any information that can be obtained to assist the development of this industry,

Now, therefore, be it resolved, That it should be brought to the attention of the President of the United States and an urgent request made that we have our share in the operating control of these factories and that we should have qualified representatives stationed there, the information gained to be used for the benefit of American industry.

Be it further resolved, That this tentative resolution be submitted at once to the Committee on National Policy of the American Chemical Society for such action as they think the circumstances merit.

....

Whereas, We find at the head of the laundry list of the Bellevue-Stratford Hotel the following notice: "Owing to dyes now being used, we will not assume any responsibility in the laundering of guests' apparel," and

Whereas, We find the similar lack of confidence in American dyes expressed by the department stores,

Now, therefore, be it resolved, That the Dye Section views with great disapproval the expression of any such misleading statements as to the quality of American dyes,

Resolved, That this tentative resolution be submitted at once to the Committee on National Policy of the American Chemical Society for final but prompt action.

The Rubber Division, but recently raised to the status of a division of the Society, presented a series of papers of a high order of merit.

In the Industrial Division, in addition to a program of more than twenty-five papers, two symposiums were conducted. Dr. A. V. Bleininger led the Re-

President and Divisional Chairmen of the Society
Seated, Left to Right: W. E. Henderson, L. W. Jones, Wm. H. Nichols, F B. Carpenter, F. O. Taylor. Standing, Left to Right: H. S. Miner, J. B. Tuttle, R. S. Weston, Chas. L. Reese, W. D. Richardson, I. K. Phelps

fractories Symposium, and the papers presented will appear in a later issue of This Journal.

The symposium on the proposal that an annual system of patent renewal fees be adopted in the United States brought out some widely differing views, and we have tried to present the discussion as fully as possible on pages 930 to 938.

The Division of Industrial and Engineering Chemistry, the Pharmaceutical Division and the Dye Section, in joint session, unanimously passed the following tentative resolution for final action by the Advisory Committee:

Whereas, The National Research Council through its Committee on Patents has made an exhaustive report on present conditions of the United States Patent Office and Patent System and has suggested remedies for present obvious defects and wise provisions for future developments, and

Whereas, Such report was adopted by the American Chemical Society as its own, and

Whereas, Bills have been introduced into Congress for the purpose of carrying those suggestions into practical effect,

Now, therefore, be it resolved, That the Division of Industrial and Engineering Chemistry, the Pharmaceutical Division and the Dye Section of the American Chemical Society do hereby unqualifiedly endorse House of Representatives Bill 5011, 66th Congress, 1st Session, being a bill "To establish a Patent and Trade-mark Office independent of any other department and to provide for compensation and infringements of patents in the form of general damages, and for other purposes," and House of Representatives Bill 7010, 66th Congress, 1st Session, as amended being a bill to increase the force and salaries of the Patent Office, and fully endorses the principle of a single United States Court of Patent Appeals permanently domiciled at Washington, D. C., as embodied in House of Representatives Bill 5012, 66th Congress, 1st Session, being a bill "To establish a United States Court of Patent Appeals and for other purposes," but without expressed opinion as to the best mode of constituting and continuing such a Court. And it is further

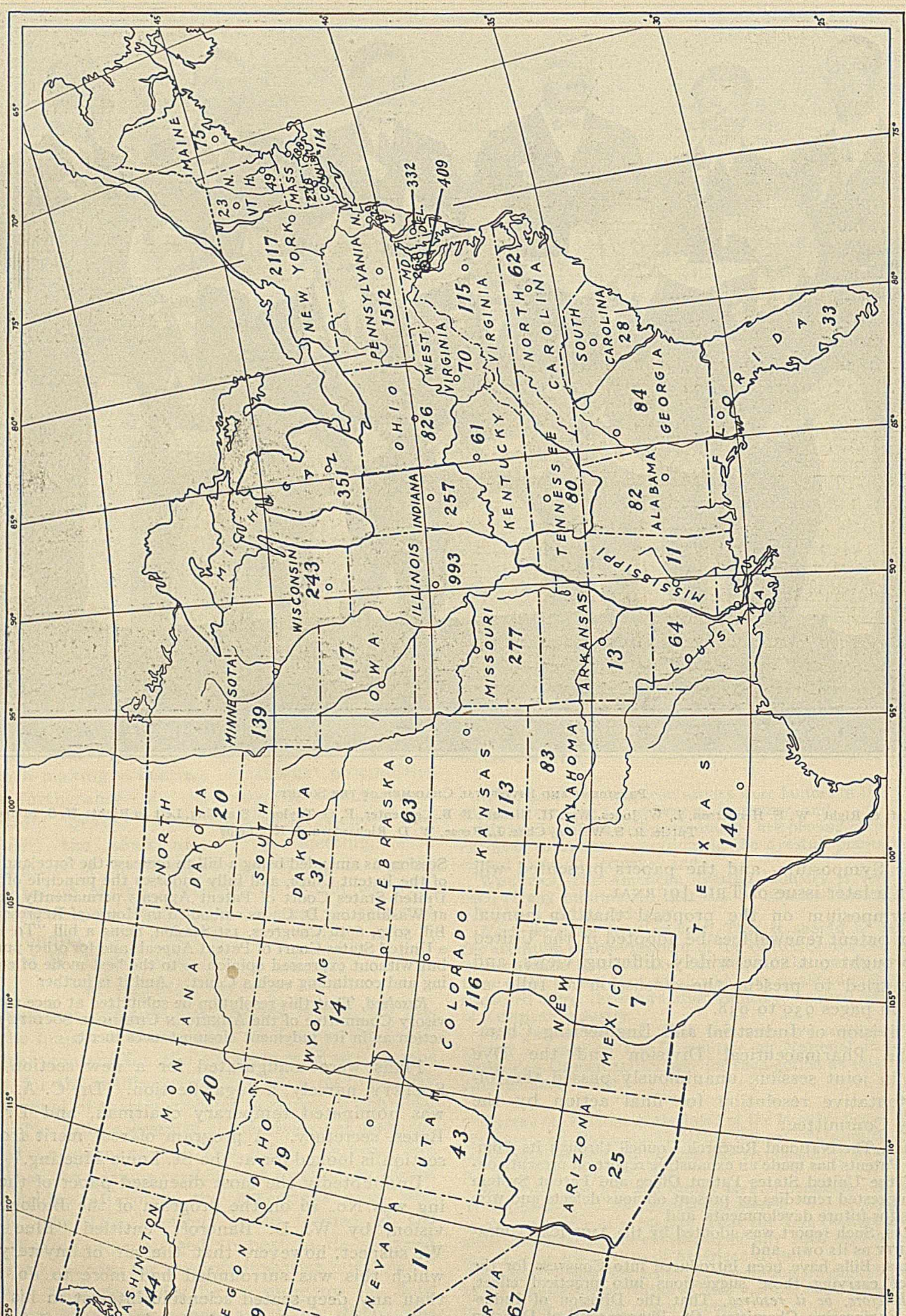
Resolved, That this resolution be submitted at once to the Advisory Committee of the American Chemical Society for such action as in its judgment circumstances merit.

Plans were inaugurated for a new section of the Society, namely, a Sugar Section. Dr. C. A. Browne was nominated temporary chairman, and Dr. F. J. Bates, secretary. A program of real merit from this section is looked for at the St. Louis Meeting.

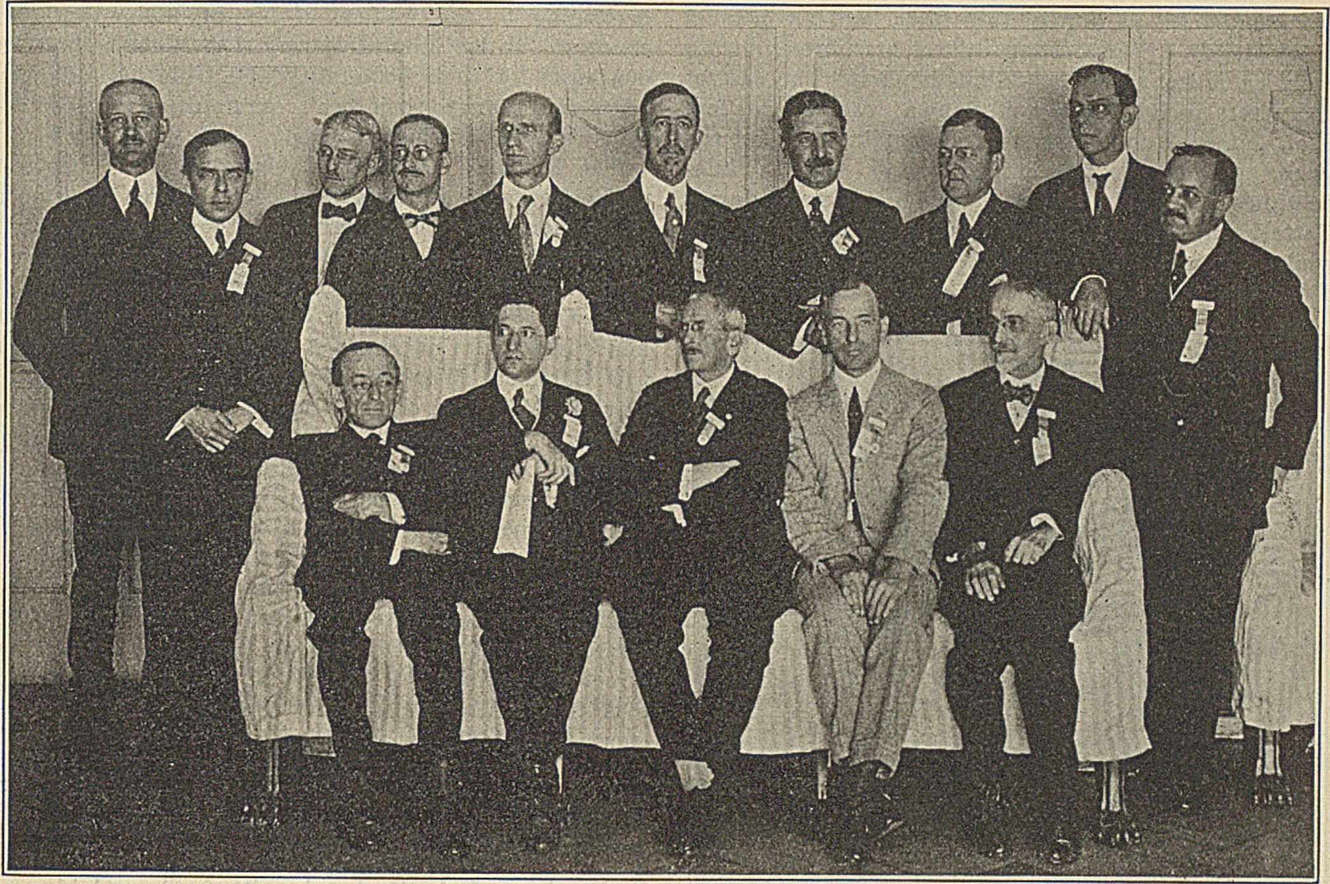
Undoubtedly the most discussed paper of the meeting was No. 16 on the program of the Biological Division, by W. D. Bancroft, entitled "Blue Eyes." We suspect, however, that the air of mystery with which this was surrounded had more to do with it than any deep-seated scientific interest in his discussion of the physical and chemical causes of color in one's eyes.

FEATURES OF THE MEETING

On Thursday afternoon, the divisional meetings took a recess in order that their members might join



Distribution by States of Members of the American Chemical Society, September 1, 1919
Resident in United States: 12,330. Foreign Members: 1286



SOME OF THE MEMBERS OF THE LOCAL COMMITTEE, PHILADELPHIA MEETING

Seated, Left to Right: Wm. C. Carnell, Sydney Davis, Geo. D. Resengarten, *Chairman*, J. H. Graham, A. M. Comey. Standing, Left to Right: W. T. Taggart, Abraham Henwood, Geo. E. Barton, E. F. Hicks, O. L. Shinn, H. S. Miner, Chas. L. Reese, C. C. Tutwiler, Leon Hoffman, Jas. A. Branegan.

the industrial excursions to some of the many factories in or near Philadelphia, where opportunity was afforded to see familiar chemical processes in large-scale operation, with the most modern of machinery and equipment.

The total registered attendance was slightly over 1700, and this number included only 170 residents of Philadelphia and vicinity. It is known that large delegations from local plants came to attend certain meetings, and it is unfortunate that in several cases these groups did not register their attendance. Such being the case, we feel safe in stating that the total attendance neared the two thousand mark.

A new and extremely useful feature, filling a real need, it seems, was the daily publication of *The Catalyst*, the official organ of the Philadelphia and Delaware Sections. This up-to-the-minute news sheet carried notices of any changes in the program of the meeting, a complete registration list from day to day, and bits of information of the sort that are often most elusive at convention gatherings.

It was pleasant to see a large banner of blue and gold, with the SOCIETY's emblem in the center, floating from a balcony of the hotel, and we suspect that Dr. Rosengarten was responsible for this innovation. On Saturday this same banner flew above the excursion boat which carried our party down the river. It has been deposited with the Secretary to be loaned for any appropriate occasion.

One of the busiest rooms was the Press and Publicity Room, carried on under the auspices of the Philadelphia Section, and under the direct supervision of Mr. John Walker Harrington. There the representatives of the press were able to secure not only correct abstracts of the papers being presented, but accurate information regarding events of importance and official action being taken by the SOCIETY and its divisions. We congratulate the Committee on the successful manner in which the real meat of the meeting was distributed to the lay and technical press of the country through the leading news associations and through special correspondents who attended the sessions.

SOCIAL HOURS

In arranging for the comfort of the chemists during their scientific deliberations, the local committee, with the energetic Dr. George D. Rosengarten as chairman, had not forgotten that the chemist appreciates and deserves a round of pleasure and relaxation. The Smoker, held at the Scottish Rite Hall, can be reported only from hearsay. We understand that good music, good fellowship, and soothing smokes prevailed, and that there was an interesting and instructive program including the premier exhibition of new "pen and ink" motion picture films, and an original play, staged by local chemical talent, portraying an early chemists' meeting in Philadelphia. The cast of characters included the well-known Joseph Priestley, Prof. James Woodhouse, Prof. Ben Silliman, and the young student of chemistry, Robert Hare. Philadelphia's venerable statistician, Mr. Edward James Cattell, entertained with a fund of rich humor, the while giving a broad view of Philadelphia's part in the chemical life of America, past and present.

Some of the Members of the Ladies' Committee, Philadelphia Meeting

Left to Right: Mrs W. T Taggart, Mrs. A. M. Comey, Mrs. Chas. L. Reese, Mrs. Harry F Keller, *Chairman*, Mrs. A. Henwood

The annual banquet took place in the ballroom of the Bellevue-Stratford, with the tables arranged for eight hundred guests. Dr. Harry F. Keller, as toastmaster, called upon Dr. Edgar Smith, Mr. Ellwood Hendrick, Lieutenant Governor Beidleman, Mr. Miner, Mr. Cattell (who had become acquainted with his audience at the smoker), Dr. Reese, Dr. Chandler, and President Nichols for remarks. Dr. Smith spoke lovingly of the life and work of that genius of chemistry, too little known to modern chemists, Robert Hare. A pleasant feature of the evening was the presentation to each guest of a portrait of Robert Hare, and Dr. Edgar F. Smith was presented with the plate from which the reproductions had been made. Mr. Beidleman expressed the conviction that what cannot be produced in America cannot be produced anywhere, and an implicit faith in the ability of the American chemist to bring forth in time what has not already appeared. Mr. Miner and Dr. Reese brought greetings from the Philadelphia and the Delaware Sections, and pledged a loyalty far above the loyalty of any particular section, to the Society as a whole. That dean of American chemists, Dr. Chandler, was heartily greeted, and as one who has seen its progress through the years, expressed his satisfaction at the present successes of the chemical industry. Mr. Hendrick plead that the chemist put himself in a position to speak with the voice of authority on matters pertaining to the welfare of his profession and his country. In his inimitable way, Dr. Nichols thanked our hosts for their hospitality and bade his audience carry with them to their local communities the inspirations received at this meeting.

The Research Division, Chemical Warfare Service, took advantage of the presence of so large a number of its members to hold a reunion banquet on Thursday evening, preceding Dr. Nichols' address, at which about 125 were present. Col. George A. Burrell, formerly Chief of the Division, presided, and the guests of honor included Col. Amos A. Fries, formerly Chief of the Chemical Warfare Service, A. E. F., Director Van H. Manning, of the Bureau of Mines, Professor Talbot, of the Consulting Board of the Bureau, Dr. Charles L. Parsons, and Colonel Wm. H. Walker. Mr. Richmond Levering, who has been active in organizing the C. W. S. Post of the American Legion, was the host of the evening. Major General Sibert, detained by official business, sent an appropriate telegraphic message. Director Manning, under whom the entire work of the Division was organized, and who directed activities for over a year, until it was turned over to the War Department, hoped that the lessons learned, particularly the spirit of coöperation developed, would be of practical value to the men in their civilian occupations, and asked continued coöperation with his Bureau in its peace-time problems. Other speakers were Colonel Bancroft, Drs. W. K. Lewis, James F. Norris, and A. B. Lamb, all of whom laid particular emphasis on the necessity of maintaining the Chemical Warfare Service as a distinct and separate unit of the Army.

Meanwhile, the visiting ladies had enjoyed a series of entertainments and luncheons, under the careful supervision of a group of Philadelphia ladies, of which Mrs. Harry F. Keller was chairman.

The Delaware Section had felt a keen desire to contribute a share to the week's program, and it happily suggested a boat ride down the Delaware River. This gave the eight hundred or more members and friends who accepted the invitation a splendid opportunity to see the industrial development which has taken place along both the Pennsylvania and the New Jersey shores. A glimpse was had of the League Island Navy Yard, and it was our good fortune to be present at the launching of the Steamship "*Sinsinawa*" at the Hog Island shipyards.

Altogether, it was a wonderful week at Philadelphia. The announced purpose of this "peace meeting" was to declare the chemical independence of America. We believe it was done as thoroughly and as sincerely as that earlier declaration which emanated from the City of Brotherly Love, and that it is fraught with untold possibilities for the future of this country. The chemists had celebrated their "victory meeting" at Buffalo, and had received a share of praise for their part in winning the war, now they went soberly and seriously about the business of putting their house in order for the era of intense industrial activity which we all believe is approaching. They had come from all directions with a deeper interest in their profession and a broader realization of its significance to the country at large, than ever before. Their papers often represented work done before the war, now they presented them in a new light, as a direct contribution to the solution of the great problems of the nation. Expressing our thought graphically, public appreciation of the chemist has taken a sharp rise, and he finds himself on a pinnacle, looking into the future with enthusiasm, and with confidence. If need be, he will fight for the protection, by license and by tariff, of some of his younger enterprises, but he will work to the limit of his ability, that the independence of his science of all foreign domination may be recognized beyond any shadow of a doubt.

PRESIDENT'S ADDRESS

RESEARCH AND APPLICATION

By Wm. H. Nichols

For nearly half a century, it has been the custom in this Society to give its president every year "his day in court," and in conformity therewith many brilliant addresses have been delivered, and almost every conceivable subject has been discussed. It is therefore becoming more and more difficult for the incumbent to select a theme which shall have the merit of novelty, unless, perchance, he is himself working in the laboratory, and can bring forth some new and shining example of the progress of his science. I have not the good fortune to be so situated, and I must perforce satisfy myself with some other line of procedure in the hope that even in a discussion of old and well-known facts, some new light may be thrown, which will not be altogether without value. I have therefore selected for my subject "Research and Application," knowing that many of my hearers have been spending their lives in considering and teaching it, and are far better prepared to instruct me than I am to reciprocate. I would remind such that there is at last a large and growing number of people who are intensely interested in what the chemist has done and is doing, and still more in what he will accomplish in the future. It is therefore rather to that public, many representatives of which are present to-night, than to the chemists in this gathering, that I would address myself.

Research in the distant past was the privilege of the few. In chemistry, during the middle ages, the alchemists were practically the only ones pursuing it, and they in secret, and not always from the highest of motives. Working by themselves, as they did, they had not the great advantage of meeting and discussing with others similarly engaged, and using their progress and mistakes to intensify their own increase in knowledge. Thus it has come about that the science of chemistry is little more than a century old, and its tremendous advances only a few decades. The first chemical society in the world was born in Philadelphia in 1793, and yet the real advances have been made since the formation of this Society in 1876. Since that time, however, the advance in knowledge has been startling, not alone in this country, of course, but in all civilized countries. It is not boasting to say, however, that during all that time, the progress in this country has been in no wise behind that of the best anywhere, which our public is at last beginning to recognize. Particularly during the trying period of the war, when vast and new problems were suddenly thrust upon them, the work of the chemists has been beyond praise.

At the foundation of all this advance, research is firmly imbedded. Without it, the structure could not have risen, or the glowing anticipations of the future even been imagined. Twenty centuries ago, we were told "Seek and ye shall find; knock and it shall be opened unto you." No one can deny that there have been accidental discoveries, some of great moment; but this has not been and will not be a safe dependence. Walking on the street one day, I picked up a roll of bills, whose owner curiously enough could not be found; but this did not lead me to give up my ordinary occupations, and wander around the streets of New York with the hope of further and continued good fortune of like character. Accidental discoveries are not to be relied on, of course, although they are not to be scorned. In chemistry the accidental good fortunes have usually come to those who were really seeking, although possibly for something different, but, note this, they were usually made by men qualified to recognize an important discovery when it flashed across their vision.

Research, of course, is not of necessity to result in invention. It may in that respect terminate in a *cul-de-sac* from which with present knowledge there is no egress, or what more frequently happens, it may lead to a line of reasoning, which in time leads to another, and so on, until suddenly a bright light illuminates the way, and a goal of the greatest possible importance is attained. Many instances illustrative of this will occur to you. I will cite only one, and that one because of the importance it has assumed in the light of recent developments.

As early as 1882 scientists rigidly established by chemical research what chemists call the "constitution" of the blue vegetable dye, indigo, and clinched that scientific conclusion by preparing the identical material in the laboratory. This particular important addition to human knowledge has remained a discovery merely; yet it so stimulated the search for practicable methods of applying that discovery to human needs that voluminous researches in a number of European countries were undertaken almost at once for that purpose. Of the host of scientific discoveries made as the direct result of chemical research in this direction, one was selected in 1897 as of such promise as to warrant the expectation that it would successfully displace vegetable indigo. Such was the ultimate fact. But, in 1901, others succeeded in devising a commercial mode of making indigo which was so formidable a rival to the mode adopted in 1897 that it seriously and at once threatened the supremacy of the latter, a thing which is now, some eighteen years later, actually coming to pass. It is worth while reflecting that the men who accomplished the scientific work of 1882 themselves never succeeded in making that work anything more than a discovery, despite the fact that for more than fifteen years they energetically tried to do so, and in their efforts they had the close coöperation of a large commercial organization. However, it remained for a college professor of chemistry in another country, himself working in quite a different field, and as a direct result of that work, to hit upon the central idea of the successful indigo mode of 1897 and to clinch it by appropriate laboratory methods. Yet his work remained for almost seven years a discovery only—a promising discovery to be sure—until the intensive work of others, overcoming many obstacles, made it serviceable to mankind. These two sets of workers were engaged in the same general class of chemical research, that is, they were working in the organic division of chemistry. As you know, chemistry is serviceably, even though crudely, grouped under two grand divisions, organic and inorganic, and for many years these were treated quite separately from each other; I know "organic" chemists who look with mild indulgence upon the "inorganic" chemists, and I also know inorganic chemists who return the compliment—with interest. In 1901, however, one of these so-called inorganic chemists in searching for new worlds to conquer, hit upon an idea which he thought would make one of the discarded and discredited methods of making indigo a worthy rival of the only commercially successful indigo method of that day. And he was right! The owners of the 1897 method were forced to look to their laurels.

The history of the synthetic production of indigo is filled with many different discoveries of how indigo may be made in the laboratory, most of them wholly unrelated to the methods of 1882, 1897, and 1901. Two, at least, of them have made an unsuccessful and short-lived attempt to grow into an invention capable of meeting competitive conditions. Now, it is curious to note that the 1901 method was an offspring of the cyanide method of extracting gold which in turn is the gold-extraction method that made the South African gold fields so valuable. Immense amounts of that deadly poison, sodium cyanide, were needed in preparation for this gold extraction; that, in turn, called for unusually large amounts of other things and among these was that particular inorganic material that gave competitive ability in the world's markets to one of the theretofore discarded indigo methods. From gold the fields of South Africa to synthetic indigo is, indeed, a long cry. Is it, therefore, not wholly reasonable to expect that from some other equally far-off branch of chemical industry or of chemical research may come the proper stimulus to bring to active competitive life some of these other discarded indigo methods or even to create new methods superior to any we know of to-day? Among chemists we also distinguish physical chemists who are curious about subjects in that great twilight zone between the field of chemistry on the one hand and of physics on the other; also we have the electrochemist who is always searching for more or less direct chemical applications of the electric current. Just as the inorganic chemist in 1901 taught the organic chemist the secret of endowing a discarded indigo method with competitive life, may we not reasonably expect that some day the physical chemist and the electrochemist may, one or both, in the course of wholly unrelated chemical research work, come across facts which when intelligently applied to the indigo problem may still further advance it?

The chemical knowledge and research that enter into the synthetic production of indigo, as we know it to-day, come from over three generations of chemists, scattered all over the globe, speaking many languages, researching on many different and separate problems which touch almost every phase of human endeavor, and the end is not yet.

For centuries indigo has been the undisputed king among dyes. Chemists have made many attempts to displace it by other dyes but it has so far successfully withstood all such attacks upon it—except as to its source or origin. Indigo is still the king, but its supremacy is threatened and threatened seriously, and its undoing, if that should ensue, is traceable directly to itself. Chemists have long felt sure that the true reason for the supremacy of indigo lay in the manner in which it dyes fabric. It possesses the unique faculty of being, what you have all so often read of in the daily papers, a "vat" dye. It is the pioneer vat dye and until comparatively recently it was the only vat dye. Vain attempts to create or imitate this vat dyeing property in other dyes are recorded by the score in the history of coal-tar dyes. But, about twenty years ago, a real vat dye was constructed in a research laboratory which ultimately turned out to have an entirely different constitution from indigo. This supplied the key to an entirely new class of dyes. Although among the multitude of "vat" dyes constructed along these new lines many are wholly worthless, there are, nevertheless, a goodly number of them having all the desired advantages of indigo, and others equally numerous, possessing highly prized advantages which indigo lacks. All of these good ones are free from certain disadvantages of indigo and, what is more important, their shades cover every tint of the rainbow satisfactorily except the reds, and those cannot much longer elude the searchers. Some day a new blue dye may result from these researches or from other researches growing out of them and indigo will no longer be king. In still other directions the chemical study of indigo has been fruitful. By proceeding along lines similar to those of the 1897 method, but displacing the nitrogen by sulfur, an entirely new line of materials has been made accessible through chemical research, and no man is wise enough to place the limit upon the directions and the extent that chemical ingenuity and research will ultimately go in this one very small field of chemical effort, which requires and draws upon all the sources of chemical knowledge we have. The possibilities seem limitless.

A PLEA FOR TEACHERS

True research must be intentional and intensive. We must really seek if we would find. We must really knock at the doors of the secret chambers of knowledge, if they are to be opened to us. We must have imagination, it is true, but we must have more than that. There must be the foundation of sound education, and the ability to extend it to embrace new and unexpected knowledge, and apply this in turn as we progress upwards.

To fit a man for research in chemistry or in any other science, many things must be accomplished before the candidate is ready to take his first advanced step. Many methods of procedure have been suggested, and some heat of argument generated, but all agree that education which produces real practical knowledge is absolutely essential. All agree, also, that the person to be prepared must be a likely subject; and that energy and time should not be wasted on those who do not show that they possess certain necessary qualifications. I think that it will also be generally admitted that the teacher himself should not only have great attainments, but must also possess the rare quality of being able to transmit knowledge in such a way that it will be truly absorbed by the pupil and form part of him. One of the greatest mathematicians I have ever known was about the poorest teacher. He knew but could not impart. The future of the world, therefore, depends in a very large degree on the teacher in the school and on the professor in the college. They have an opportunity to mold the world, which many of them thoroughly appreciate. Alas, in most instances, the consciousness of work well done is about their only reward. Some day, and I hope not a very distant one, it will be generally recognized that, like other laborers, they are worthy of their hire, and their compensation will more nearly approximate the value of the work done. When that happy day arrives, they may experience a little less of the satisfaction of sacrifice, but they will have other comforts and hopes which will more than make this up to them and to their families. Like others before me, I advise the people of this country that they can make no better investment than one liberal enough to cause the teaching profession to attract not only those whose high sense of duty leads them to embrace it at a sacrifice, but also those who cannot afford to make the sacrifice, however anxious they may be to do so. Men preparing for research must have the best men in the country to guide them, and it is not fair to expect these men, as so many have done in the past, to live the narrowing life of poverty. Neither is it wise.

There are a few foundations specifically provided for chemical research, such as the Warren Fund of the American Academy of Arts and Sciences, the C. M. Warren Fund of Harvard University, and the Wolcott Gibbs Fund of the National Academy of Sciences. There are a number of foundations for promoting research generally which have included chemical research within their fields, such as the Bache Fund of the National Academy of Sciences and the Elizabeth Thompson Science Fund. The Rockefeller Institute for Medical Research fosters chemical research contributory to its main object and the Carnegie Institution of Washington supports chemical research in its general policy of advancing knowledge through research. The newest of all is the fund recently placed at the disposal of the National Research Council for stimulating chemical research. There is need for many more foundations if we are to keep pace with the rapid strides of civilization, or better still, to determine the direction they will take.

The importance of research is being more and more recognized and understood by the public. One of the most encouraging evidences of this is shown in the preamble and resolution adopted recently by the American Federation of Labor at Atlantic City, indicating, as these do, a clear appreciation by that great association of how much we all depend on what science will disclose to ameliorate the conditions of the future. It is well worth while to read these in full here:

> WHEREAS, Scientific research and the technical application of results of research form a fundamental basis upon which the development of our industries, manufacturing, agriculture, mining, and others must rest; and
>
> WHEREAS, The productivity of industry is greatly increased by the technical application of the results of scientific research in physics, chemistry, biology, and geology, in engineering and agriculture, and in the related sciences; and the health and well-being, not only of the workers but of the whole population as well, are dependent upon advances in medicine and sanitation; so that the value of scientific advancement to the welfare of the nation is many times greater than the cost of the necessary research; and
>
> WHEREAS, The increased productivity of industry resulting from scientific research is a most potent factor in the ever-increasing struggle of the workers to raise their standards of living, and the importance of this factor must steadily increase since there is a limit beyond which the average standard of living of the whole population cannot progress by the usual methods of re-adjustment, which limit can be raised only by research and the utilization of the results of research in industry; and
>
> WHEREAS, There are numerous important and pressing problems of administration and regulation now faced by federal, state, and local governments, the wise solution of which depends upon scientific and technical research; and
>
> WHEREAS, The war has brought home to all the nations engaged in it the overwhelming importance of science and technology to national welfare, whether in war or in peace, and not only is private initiative attempting to organize far-reaching research in these fields on a national scale, but in several countries governmental participation and support of such undertaking are already active;
>
> *Therefore be it resolved*, By the American Federation of Labor in convention assembled, that a broad program of scientific and technical research is of major importance to the national welfare and should be fostered in every way by the Federal Government, and that the activities of the Government itself in such research should be adequately and generously supported in order that the work may be greatly strengthened and extended; and the Secretary of the Federation is instructed to transmit copies of this resolution to the President of the United States, to the President *pro tempore* of the Senate, and to the Speaker of the House of Representatives.

I hope and believe that this matter coming as it does from a new direction will be most seriously considered by the proper authorities—not that it has not already been well understood in Washington, but that renewed interest may be taken and even more liberal appropriations granted. The Federation resolution urges that "a broad program of scientific and technical research is of major importance to the national welfare." Good! Now that everybody is agreed, how was it possible that for so long a time this belief was held by so few, and these composed almost entirely of men of science? The question, therefore, is squarely before the country, and the urgency of it thoroughly appreciated by those who have the most to gain by it, namely, the workers on whose efficiency so much depends. Now this opens the way to a scientific solution of vital questions about which there have been such fundamental differences of opinion, based largely on what may be called the point of view. People have divided themselves into classes—a very dangerous course—and many, a very great many, have actually believed that there must of necessity be a deeply rooted difference between capital and labor, and that the true interests of either were entirely apart from those of the other. Many have held that labor is a commodity which it was to their best interest to get the most of for the least money, while many others believed that labor was the sole source of all wealth, and that the fewer hours worked, and the smaller the output of those hours, the better it would be, somehow or another, for the laboring classes. I have cited the extreme views for purposes of illustration, realizing that somewhere between the two would be found the great body of all reasonable and thoughtful men. We may leave out of consideration here that ultra-extreme class who teach, whether they believe it or not, that the true interests of labor would be best served by sabotage and syndicalism, and all the other fantastic notions which have of late years been more or less in evidence, and liable to catch the unwary. To these, research presents no attractions.

AN OFFER TO LABOR

Now I am going to venture to suggest to the working man, who is earnestly desirous of bettering his own and his family's condition, that there are a good many sciences besides chemistry and the engineering and abstract sciences in general. Some of these he is better able to study and practice than any one else. Many of the fundamental truths concerning labor and its conditions would never be discovered by the scientist *per se*, because he has not had the benefit of practical preparation. Let our friends of the American Federation of Labor not be content with what the Government can do in the line of their resolution, good as it has been and will be, but let them start a carefully planned series of researches themselves, and follow them up until the truth stands revealed. They can depend upon the assistance of this great SOCIETY. The employers of labor have been doing this for years, singly and in groups, seeking the same end. The shining goal of all research is the truth, the whole truth, and nothing but the truth. Thus, starting from different angles, with fairness and thoroughness, the various so-called interests will arrive at the same truth, for there can be only one truth concerning any question. Thus will it come to pass that capital and labor will discover that the true interest of one is the true interest of all, and instead of bickerings and suspicions we will have that cordial coöperation which is absolutely essential if we would get the best out of this good old world of ours.

Scientific discovery is really not a haphazard matter. The art of making it can be cultivated, and definite rules of research can be laid down. Many elements enter into the problem, and these have been very well tabulated by the late Dr. Gore, F.R.S., in his book, "The Art of Scientific Discovery." While the list he gives may not be complete, it is so nearly so that it is well worth quoting here. His table is as follows:

1—Aid to analogy
2—Hypotheses
3—Analysis and synthesis
4—Application of (*a*) Electricity to bodies; (*b*) Heat to substances
5—Asking questions and testing such questions
6—Assumptions that:
    (*a*) There is certainty of all the great principles of science
    (*b*) Complete homologous series exist
    (*c*) Converse principles of action exist
    (*d*) Certain general statements which are true of one force or substance are true to some extent of others
7—Combined action of many observers
8—Comparisons of:
    (*a*) Facts, and collecting similar ones
    (*b*) Collections of facts with each other
    (*c*) The orders of collections of facts
    (*d*) Facts with hypotheses

9—Deducting process
10—Employment of new or improved means of observation
11—Examination of
    (a) Common but neglected substances
    (b) Effects of forces on substances
    (c) Effects of contact on substances
    (d) Effects of extreme degrees of force
    (e) Extreme or conspicuous instances
    (f) Influence of time upon phenomena
    (g) Neglected truths and hypotheses
    (h) Peculiar minerals
    (i) Unexpected truths
    (j) Rare substances
    (k) Residue phenomena
    (l) Residues of manufacture
    (m) The ashes of rare plants and animals
12—Extension of:
    (a) The researches of others
    (b) The researches of neglected parts of science
13—Inductive process
14—Investigations of:
    (a) Exceptional cases
    (b) Unexplained phenomena
    (c) Classification unexplained
15—Means of:
    (a) Converse experiments
    (b) Hypotheses
    (c) Homologous series
    (d) Instruments of great power
    (e) Improved methods of intellectual operation
    (f) Measurements
    (g) The method of curves
    (h) The method of least squares
    (i) The method of means
    (j) The method of residues
    (k) New instruments
    (l) Modes of observation
    (m) Observations
    (n) More intelligent and acute observation
    (o) Additional observations by known methods
    (p) Periodic functions
    (q) More refined methods of working
    (r) Repetition of experiments
16—Simple comparisons of facts of phenomena
17—Search for:
    (a) So-called "impossible" things
    (b) One thing and finding another
18—Subjecting series of forces or substances to new conditions
19—Use of:
    (a) Known instruments or forces in a new way
    (b) Improved instruments
    (c) More powerful instruments
    (d) Causes by the methods of averages
    (e) Coincidences
20—Conditions of:
    (a) Scientific discovery
    (b) Determination of the nature of a discovery contrasted with barren reasoning
21—Dependence of discovery upon art of exceptional instances
22—Fundamental laws of discovery

Research does not always lead to discovery, nor discovery to invention, but the sequence is logical. Gore defines the difference between discovery and invention in these words: "Discovery consists in finding new truths of nature, while invention consists in applying those truths to some desired purpose;" and that definition is sufficiently accurate. The natural application of research is therefore invention. How can this application and its corollaries best be carried out?

The concrete application of a truth is of course necessary for its widest usefulness. There are various theories as to the best way of accomplishing this. Take our old friend Wackford Squeers, for instance, a highly interesting character in one of Dickens' best books:

> "This is the first class in English spelling and philosophy, Nickleby. Now then, where's the first boy?"
>
> "Please, sir, he's cleaning the back parlour window," said the temporary head of the philosophical class.
>
> "So he is, to be sure," rejoined Squeers. "We go upon the practical mode of teaching, Nickleby; the regular education system. C-l-e-a-n, clean; verb, active, to make bright, to scour. W-i-n, win, d-e-r, der, winder, a casement. When the boy knows this out of a book, he goes and does it. It's just the same principle as the rule of globes. Where's the second boy?"
>
> "Please, sir, he's weeding the garden," replied a small voice.
>
> "To be sure," said Squeers, by no means disconcerted. "So he is. B-o-t, bot, t-i-n, tin, bottin, n-e-y, ney, bottiney; noun, substantive; when he has learned that bottiney means a knowledge of plants, he goes and knows 'em. That's our system, Nickleby; what do you think of it?"

During the intense pressure of recent years, this Squeers system has had a good trial, and seems to have left more or less to be desired. The taxpayer knows the sequel, and will be reminded of it from time to time for the rest of his life.

The application of research has always required a high order of talent. In the future a still higher order of talent will be necessary, but in addition this talent must be prepared by education to do this very thing. Sir Robert Hadfield, F.R.S., has said, after England had been struggling with belated preparation for nearly two years:

> Until quite recently many mistakes were made, either because the scientific man had been installed in view of his special knowledge, or, at the other end of the scale, the practical man was given the preference. In a general way neither of these types has been a success.

Admitting Sir Robert's conclusion, how can we produce the leaders who shall adequately combine both qualifications? That is one of the greatest and most interesting problems awaiting solution by our educators, and on its correct solution depends in a larger degree than many imagine, the future of successful and contented industry in this country. I shall not attempt, in the presence of so many educators of acknowledged ability to show the way, even if I felt persuaded that I knew it, as the matter is of too great consequence to run the risk of an amateur indicating the wrong road. I shall content myself by pointing out the need, with the hope of turning the attention of the great public to its existence. In our free country, the people generally get what they really want, and it is worth while to lead them to want the greater things, and not to be satisfied with the lesser.

There are certain fundamentals, however, that all will agree to, if it be true that the leaders of the future will have far greater problems to solve than have yet been conceived.

(1) The candidate for leadership should have a healthy body. Great things have been accomplished by men and women of fragile physique, but they would have accomplished greater if they had not been thus handicapped.

(2) He should have good habits, which involves good character. This is vital if we would have leaders who would be a blessing and not a curse. We can easily call to mind men of splendid health and intellect who used these gifts to the injury of their fellows, and not to their advantage. Do not waste time or energy in educating for leadership a man of bad or doubtful character or whose aims are selfish.

(3) Of course he should have a good mind, educated to the highest degree attainable. This education should be specialized in the desired direction, while good all around. No really great leader can be lop-sided if he would avoid being a "crank."

(4) He should have a thorough knowledge of human nature. To play on the "harp of a thousand strings" requires an unusual acquaintance with the instrument. How many men otherwise great have broken down here, sometimes because they have given too much confidence, sometimes not enough, sometimes because they did not know how to select assistants. The knowledge of human nature is a great gift in itself, which can be acquired and increased. It lies at the foundation of wisdom, which King Solomon pronounced the "principal thing."

With the qualifications enumerated and others which will occur to you, the candidate for leadership is well equipped. To direct him to full fruition is a noble task. Let us proceed to fill our high places of every kind with men and women specifically prepared to fill them, being assured that the effort to do so will produce an army of those not quite qualified for the top, but of the greatest value to assist those who are, and who without such aid would resemble "faith without works," which, we are told, is "dead being alone."

Research leads to discovery. Discovery to invention. Invention—no one knows where. Applied and supervised by those prepared for the task, the strides of progress will be long, and the benefit to the human race in proportion. Let us educate for living, certainly—but let us also educate for leadership—that superlative leadership of which civilization will stand more and more in need, as it increases in complexity, and reaches higher and higher planes.

CHEMISTRY IN WARFARE

By Newton D. Baker, Secretary of War

I am here, Mr. President, obviously not because I can make any helpful contribution to the great scientific subjects which engage the attention of this group of men. I suppose there is scarcely anybody who would be less competent to discuss even the most elementary chemical problems than I. I am here because the Government of the United States, and particularly the War Department, owes a debt of gratitude and appreciation to the chemists of the United States, to which I want to give the most formal public expression.

There are, I am told, some seventeen thousand chemists in the United States. Practically one-third of all the chemists of the United States were directly in the Government Service during the recent war. One-third of them were engaged in essential war industries, and the remaining one-third, outside of those who were attached to colleges (and even they were busy about war work), were all engaged in war work at home, of one kind and another, so that while comparisons are impossible in a great national mobilization of the sort we have had in which every art and every profession and every craft was appealed to, and responded with unanimity and patriotic zeal—while comparisons are impossible, I do not believe it will be discovered that any profession contributed a larger per cent of its members directly to the military service, or the results of the activities of any profession were more essential to our national success than that of the chemists.

I am aware this war has shown some very remarkable illustrations of "group contributions." Perhaps the doctors, taken as a class, made as great a contribution to our success in war as any others. This is the first war in which America has been engaged—and, indeed, I think it is the first war in which any civilized nation has engaged—in which deaths from disease are less numerous than deaths from battle wounds. Those of you who are familiar with Tolstoy's "War and Peace," or have read the story of Florence Nightingale, and know what the camp-bred diseases did to armies one hundred years ago—those of you who are familar with the fact that ordinarily, until quite recently, the relative rate of mortality from disease, as compared with battle wounds, was five to one, will realize what enormous advance has been made by the medical profession, which is at least "first-cousin" to your own science, in the prevention and cure of disease.

In the Spanish War and Japanese-Russian War, the contending sides, leaving out Spain (the mortality in whose armies I do not happen to know)—the Japanese, in their war with Russia, and we, in our war with Spain, brought the disease rate about on a par; but in this war, had it not been for the wholly unexpected and unpredictable epidemic of influenza, which affected civilian life as well as the military, battle deaths would have been higher by two or three to one, than disease fatalities. That was due to the fact not only that medical science has made giant strides in the last ten or fifteen years, but to the fact that in the medical profession, as in the chemical profession, the masters of that art, the greatest surgeons and the greatest physicians, left their hospitals and their practices, left their private business just as you left your laboratories and industrial institutions, put on the uniform of the Army of the United States, threw aside the tunic or gown of the student, put on the uniform, and went wherever the call of duty was—from the front-line trenches to the home front—in an effort to serve the nation and its cause.

The Chemical Society presented a striking instance of preparedness. I am told by the newspapers, that one of the very large number of investigating committees of Congress has discovered that the Council of National Defense and the War Department were busy about the mobilization of America actually before war was declared, and that is regarded as a very serious indictment. I think I had better plead guilty. The proof will overwhelm me if I don't. But when the National Council of Defense was formed, it grew out of an idea—I think of Mr. Howard Coffin—that there ought to be somewhere in the United States a schedule of the industries of the United States, and of their capacity, and the facility with which they could be transformed from one form of production to another; to that idea was added one by Hollis Godfrey, who lives here in Philadelphia. Dr. Godfrey's idea was, there ought to be a tabulation and schedulization of the talent of the country; that we ought to know how many chemists there are and what kind of chemists, whether research men or engineers in chemistry; we ought to know how many physicists there are, how many could be used in sound ranging and experimentation; there ought to be an index of the leaders of thought in America. Those two ideas, I think, were the germinal ideas from which the National Council of Defense was formed, and when Congress authorized that group to get together, as the National Council of Defense, it was long anterior to our entry into the European War. Its first business was to prosecute to an end those two inquiries, so that we did have in Washington a catalogue of industries, their location and their availability by transformation from one form of production to another, and the materials on which they were obliged to rely, the substitute materials which could be used in the event of certain raw materials becoming unavailable for one reason or another, and we began to have a more or less comprehensive index of the trained minds of America. That became vastly important during the war, but we found to our very great surprise that very few of the professions of the country were integrated in any such manner that would make them available for rapid mobilization and use. The doctors, for instance, were remobilized by Dr. Franklin Martin and his associates and an entirely new classification was made of them. It was speedily done; adequately done.

SOCIETY WAS READY

But when we came to the chemical science we found that the American Chemical Society certainly had the largest body of its kind in the world and comprised in its ranks 14,500 of the total 17,000 chemists of the country, and when the country's call went out for chemists, the coöperation of this Society was a splendid substitute for any preparation the Government had to make, and almost instantly the Government was able to put its hand on the man who was needed for the particular job, to call him into Washington or service wherever he might be needed, or wherever might be needed an adequate group of properly prepared men to undertake the solution of any problem, so that your Society was by its very existence anticipatory of the calling into being of the forces to collect these data, and the Government owes to this Society, therefore, a debt of gratitude for this closeness of association and intimate knowledge of the profession, which it was able to place at the Government's disposal and thereby to render a chemical knowledge of the country speedily available.

I might go on through the work done by the chemists of this country and enumerate outstanding achievements which they accomplished in the war, and yet these must be better known to you than to me: the work of the Chemical Warfare Section of the Army, the devising and inventing of new gases for offensive warfare; the more effective preparation of charcoal for use in gas masks for defensive warfare; the association of chemists with the Bureau of Standards and other government agencies in working out non-inflammable dope for aëroplanes; the production of synthetic phenol—I have not struck in every instance the most important contributions, but from the beginning of our entrance into the war, until the end of it, the chemical mind was at the highest tension and was emitting sparks of great luminosity to the very end, with rapidity and with success, and although we were in the war relatively a brief time, there has already been written a substantial volume which I think has been called "The History of the First Chemical Regiment," which tells of the successes of an American regiment organized as a chemical fighting unit with flame projectors and gas throwers and all the other paraphernalia of this modern war, operating effectively and contributing to the victory on the Western front.

The chemists did their share. They did it superbly. No tribute which I can pay to them would be too high and yet I want to look just a little at the future as the main point of emphasis in the remarks I am making to you this morning. We have learned some things now about war. War has changed, both quantitatively and qualitatively. It has changed qualitatively, as suggested by Dr. Nichols, in the introduction of the aëroplane, submarine and chemical war instruments. Quantitatively, it has changed in the size of the masses engaged in war. I suppose when men fought who had to go to battle on the backs of elephants and camels, relatively small groups could go: somewhat larger, however, than when they had to walk. When the elephant and camel gave place to the fleeter horse, and horse-drawn vehicle, with the rotary motion of the wheel, larger numbers could go; when we had the steam locomotive with the fixed track, that enabled us to mobilize still larger numbers, but now that we have electric traction and have added together this new and those old methods of transportation, the limits have been taken off, and in this war we have had the great civilized nations dealing in units of millions of men instead of units of tens of thousands of men. If the degree of progress needs any illustration one has but to compare what seemed the magnificent armies that contended on the field of Gettysburg with the armies which occupied the Western front, from the British Channel to the Swiss Frontier—we must substitute millions for tens of thousands.

I saw a picture not very long ago which illustrated the quantitative changes of war. This picture illustrated a 3-inch gun being fired by ten men, and back of it, for the purposes of contrast, was pictured a factory with its employees numbering 300, outside at the mid-day recreation, I suppose, and the legend underneath the picture stated: "It requires a factory of this size and this many employees, working continuously, to keep that gun firing continuously." One gun and ten operatives kept going by 300 production operatives and a factory. Now, as we brought the world into this mobilized condition, as millions of men marched up and down the earth in uniform and as troops were conveyed across the seas, the system and service of supply back of all this required, of course, corresponding anticipation, and probably there is no feature of General Pershing's great work outstanding more prominently than that he had the imagination and foresight to see ahead the sort of service that was necessary to maintain all this, to put into being the things that would bring about all this—the building of docks and facilities of all sorts, railroads, the sending over of cars and engines, the creation on a white sheet of paper in France of a large specimen of America's industrial capacity. Yet all that was a part of the fighting front, and back here at home the nation had to be mobilized just as intensely, until really our mobilization for this war ran from the trenches in France to the remotest farm in the United States, and thus the character of modern warfare qualitatively considered is such that if in the future there is a war in which the United States is engaged there must be a mobilization, first, of the man power; second, the money power; and third, the means power of the people.

NECESSITY OF CONTINUED MOBILIZATION OF NATION

We have learned in this country that when we come to the mobilization of our man power, the United States accepts as axiomatic the application of the democratic principle of selection by compulsion of the Government and assignment of the individual to the task rather than an election of the individual of his choice in the national defense. I think we will accept that not only because it is obviously fairer, but because it is the only plan by which an effective mobilization of the man power of the nation can take place. If we had allowed the chemists, for instance, in this war to follow their own bent, they would have been in the front line trenches, with guns in their hands; but it was necessary for us to have the interest of the whole people in view so that we could say, "Your duty is where you don't want it to be—with a test tube in the laboratory, and not with a gun in Flanders."

The mobilization of the financial power of the United States has been rendered very much more possible in recent years by the adoption of a national system of banking in our country from which we think now we will never depart because national interest requires national control—our business life depends on it, as well as the safety of the nation in time of crisis.

Man power and money power seem to lead up to "means power"—the mobilization of the facilities of the nation, the mobilization of its brains on one side and its wheels on the other; the mobilization of its raw materials and the means of converting them into the finished product; the way of bringing back of the nation the concentrated industrial capacity of the nation which must always hereafter be an element of the forethought of those who have in mind the possibility of a great national crisis of the kind through which we have just passed. I share Dr. Nichols' hope expressed a little while ago—this is the city of the Quakers and surely this is a proper place to have emotions and sentiments of that kind—every place should have it. I assure you that I share his hope that mankind will never be called upon to mount the altar of sacrifice in the fashion it did in the last three years. I think no other thing is so important to be done; nothing else is so worth while; nothing so moral; no duty calls with such insistent demand, as to do all we can with heads, and hearts and hands, to make a just peace permanent throughout the world.

I have been on battlefields; I know what war means. I have been in hospitals—I go to them yet—filled with the wreckage of this war; and when you think this is but a sample, and count up the cost of this war—nine or ten million men in the flower of their youth, the strongest, the most virile out of all the most civilized nations of the earth, *dead;* when you count the orphanage and widowhood, the withdrawal of that vast energy from the productive forces of civilization; when you think of the waste of only the material side, the amount they spent in money, two hundred thousand million dollars—and if you try to get some idea of what that is, you look in the world almanac and find the total value of the United States—of all the real and personal property in it, all the houses and all the lands and all improvements thereon since they took it from the Indians, telegraphs, jewelry and money, all of it added together amounts to one hundred and eighty-six thousand million dollars—when we think of these things we are filled with amazement. We have paid, not with king's ransom, but with the price of civilization and we have wasted a heritage greater in value than the aggregate value of the greatest country that ever existed on the face of the earth. I assure you I share Dr. Nichols' hope, and I share it most fervently, that we will never again be called upon to throw down that kind of gauge in battle. But I had that hope before the last war. When I was told Austria had declared war on Serbia, and Germany had declared war on Russia, and Russia had declared war on Germany, and Austria, and France had declared war—I said it can't be; it is impossible; that sort of loss of head might happen in an institution for sickly people, but great civilizations can't go mad over night and bring that sort of destruction on the world. I don't know whether it is possible in the future or not, but I do know that there are some things worse than going to war; there are some elements of civilization which it is better to fight for than to lose, and if the price of human liberty, the cost of perfecting our civilization, of having the freedom of spirit our democracy gives, the elevation of the soul we have long known—if the price of the preservation of this is another war, I am ready.

In any event, in the present state of mankind, it is important that we should be aware of that possibility and take those forward looking steps which, if the emergency ever comes, will enable us to do two things: first, focus our power quickly and effectively for the accomplishment of our end; and second, so wage war that we will do it with the least loss of life to the men whose lot it is to take rifle in hand and occupy the front line trenches. Therefore, it is highly important for us to bring about those arrangements which will enable mobilization of the "means power" speedily to be made.

NEW SYSTEM OF ARMY EDUCATION

We are undertaking now in the Army completely to transform the system of education in the Army. Only yesterday I was present at the opening of what is known, or what is to be known, as the "Staff College" of the Army. The old War College was a somewhat composite and many functioned institution; it has passed out of existence and the "Staff College" takes its place; it presides at the top and under it are the schools at Leavenworth, Fort Monroe, etc., where proficiency in the special branches of the Army is taught and under them come West Point and schools in which many of you are professors, the technical universities out of which young men come into the Army with the gifts you have given them. Our system of schools is to further educate them and to coördinate the education which they bring to the new purpose to which it may have to be put.

We are planning education in the Army itself so that in the future the Army of the United States will not be one hundred thousand or two hundred thousand men who have enlisted because they had fallen out of temper with the adjustment of things at home, and were not perfectly able to get along with their old neighbors, or some other cause of that sort. Rather the object is that a young man may come into the Army to get an education, and the Army itself, instead of being a mere disciplinary institution will be a useful agency, adding to the popular schooling of the people of the country, and turning men back to civilian life after they have finished their period of enlistment with crafts and callings which enable them to be more useful citizens in their communities. Your president has offered to have some lectures made at West Point by eminent chemists. I have insisted that he himself give the first lecture. We have established at Camp Humphreys, outside of Washington, a great Engineering School—you must not tell anybody, but the plans for that group of buildings comprise an ultimate cost of probably twenty-five million dollars. Congress won't do that if you tell them how much it is going to cost. That institution is to have, not merely the training school for engineers—and by engineers I do not mean civil engineers, but chemical engineers and civil engineers, all the men who constitute the bridge by which abstract science is put into practical use—not merely a training school for engineers, but alongside of it and as part of it, a great research institution, in which the best brains of the Army and Navy, by invitation, will be operating to make fresh application of scientific discoveries to war uses and adaptations, and to which the chemists and physicists and engineers of the country will be invited to come as guests of the nation, in order that they may pool their learning to devise other modes of warfare against the time of emergency. It means an interchange of views between the scientists and the military men, so that if the hot breath of war does come sometime again and we are summoned once more to mobilize the man power, the money power and the means power, it will be available and ready for use, and the demonstration of the virility of democracy will be even more superb than the one we have just given.

This has been stupendous, gentlemen,—stupendous for the United States. Many of us now are in a questioning mood. The artist, after he has painted a picture, always has a moment of relaxed energy and disillusionment. No picture that ever was put on canvas was as exquisite as the dream of the artist and so, now when the intensity of our effort is past, when this fierce concentration upon a single set of ideals and single objective has been withdrawn, we are placid and sometimes flabby in our relaxation, and are doubtful and questioning as to what the present is, and what the future will be. But this war teaches us what the present is and what the future will be. A nation which was able in a year and a half to build the greatest army the world ever saw—and I speak no words of idle, unthinking compliment of that army—it was the soberest, sanest and least criminal aggregation of men of its size that ever stood together on this planet—a nation which has gone through that experience has learned some potent and saving lessons for its future.

Just a word of illustration: The chief scientist of the American Army was called upon to make a census of the hospitals in France, in which over 200,000 American soldiers were, to discover the characteristics of certain epidemics among the men, and he found not a single soldier in a hospital due to delirium tremens—not one out of two million men. There was a lower percentage of suicides, a lower percentage of insanity and a lower percentage of crime in the American Army and American Expeditionary Force, by actual figure, than has ever been true of any army in any country or of any equal civilian population of our own country. A country which has gathered such an army together and sent it over-seas; which has responded with such success to its scientific and material problems; a country that so adequately clothed and equipped and maintained its men and had its army singing as it marched to victory in defense of ideals which were totally devoid of any tarnishing by selfish aims, shows an undiminishing virility and vigor which makes us confident of the present and makes the future very sure. These young men have saved a high and promising civilization. The world is uneasy for the moment. Its losses have broken its heart and disarranged its efforts. The loss of man power in the world is great; it is more difficult than formerly to induce persons to work, and we are going to have to substitute mechanical processes to fill the place of work—to make civilization in the future not dependent on hands; we have wasted hands; they are not here any more. The ultimate answer for that must come from the chemists and artisans. Everywhere this beautiful thing, erected in this country, this civilization more progressive and effective and beautiful all the time, reared on liberty and justice, and the democratic institutions established by our forefathers, is far too precious a thing not to conserve and develop. There will be a new union of spirits for the tasks of peace, as there was a union of spirits for the task of war. We will all join hands to bring about a more effective civilization than we have had heretofore.

CHEMISTRY AND THE NAVY

By Rear Admiral Ralph Earle, Chief, Bureau of Ordnance, U. S. Navy

In the spring of 1917 as a member of the U. S. Nitrate Commission, I first had the pleasure of meeting your Secretary and other well-known members of your great Society, one now some forty-two years old, and one having a membership of 13,600 or practically the largest organized body of scientific men in the world. My associations with these men have proved most valuable to my bureau, that of Navy Ordnance, during the war, and will continue to do so in the long years of peace which we have justly earned and must preserve.

The necessity of increased production of munitions involving all types of chemical mixtures and compounds requires chemists in large numbers, not only to inspect and analyze the substances we were using, but to develop the necessary new ones. To locate such men and enroll them I took advantage of the means your Society opened to me through Dr. Parsons. Thus the Navy early acquired its necessary force in laboratory and factory. The chemists secured came in, some as officers, others as enlisted men. This Society's register enabled those in the service to be recalled from sea and stationed on shore where the Navy could utilize their education to better advantage. Thus in the inspection service alone we acquired a large number of scientific men through this body.

Ledger Photo Service, Philadelphia

Seated, Left to Right: Secretary of War Newton D. Baker, Dr. William H. Nichols, Rear Admiral Ralph Earle.
Standing Left to Right: Dr. George D. Rosengarten, Dr. Harlan S. Miner, Officers of the Philadelphia Section, A. C. S.

At the time of the Spanish war our Navy was still using for its powder a mechanical mixture of saltpeter, sulfur and charcoal known as brown hexagonal powder, no smokeless powder fabricated having up to then satisfied the Navy. Now our Navy's and Army's powder is that nitrocellulose product made possible by Vielle's work with Nobel's guncotton, Mendeléeff's colloiding, and Francis du Pont's dehydrating. This powder is stable and regular, a development of long years of peace, a chemical compound that is attributable to chemists, some of the most able in the profession having given their time and study to it. Its record is a testimonial to efficiency, and to the fact that the purer the substances and the more closely our powder approaches one substance, the more stable it is. What a comfort it is to the men who sleep with and over it to feel that the staff of men working in its development neglected nothing and gave the Navy a safe and most efficient propellant. To maintain this pure and stable the chemist is ever needed. The alcohol, the cotton, the ether and acids must be just right or trouble will develop later. Even the study of cellulose is a world in itself.

The problems of the naval service differ in one essential particular from those of general military service, in that their limitations are set by the conditions in which they must be used aboard ship and at sea. Stability, that is capacity to stand storage under adverse conditions of moisture and temperature, assumes an importance which it does not carry in military operations where munitions are expended almost as rapidly as manufactured. Many of the explosives proposed by men of science for naval use cannot so stand the conditions of stability required.

Among such proposed explosives, the ammonium nitro compounds or mixtures were most prominent. The use of ammonium nitrate powder as a propellant was advocated by an eminent chemist to relieve the almost certain shortage of materials for the nitrocellulose compounds used by the Navy. The same lack of stability rendered them unsuitable for even the still more extensive use in mines and torpedoes. The hydroscopic character prevents their storage even in well ventilated magazines and when assembled in impervious packages.

The powders having nitroglycerin in their composition for reason of insufficient stability and others are not suited to the Navy. The attempt to avoid excessive corrosion was one of the causes which led to the adoption in this country of a pure nitrocellulose powder as a propellant instead of nitroglycerin compounds used generally in the European countries, with the exception of France. Here again in this field some of the most extensive chemical experiments have been carried on for many years, the difficult element of the problem, in whatever form of explosive, being the lack of experimental knowledge on the behavior of chemical compounds when subjected to high temperatures and pressures, exceeding often many times those under which they can be manipulated in the laboratory.

The chemical reactions under pressures and temperatures that cannot be reproduced in laboratory are well discussed by M. Berthelot. The relations of detonation and explosion are complex indeed.

There is a need in the Navy of the development of a powder with the minimum amount of flash. Now at night the gun pointer, or, as in the case of "Broke" and "Swift" engagement, in the English Channel, the navigator is blinded for several seconds. To effect this some smoke must be accepted, but, with the high speeds or winds at sea in a modern engagement, particularly on destroyers, the smoke given off by the discharge will quickly pass astern and not interfere with the gun pointer or navigator. The blinding effect of a flash from smokeless powder at night cannot be realized by those who do not actually know it. Chemists are now at work on this problem but before a satisfactory solution is reached, more attention must be given to it. Possession of satisfactory star shell and flashless powder for use in an engagement at night will change its character in a large measure. A flashless powder to be satisfactory must, of course, suit the guns at present in use in the Navy.

The extensive development of high explosives during the recent war has shown the close relation between organic chemistry and ordnance.

Wet guncotton has been discarded as an explosive for torpedo warheads on account of lack of stability. The danger of its drying out and becoming easily exploded by shock or other cause led to the substitution of TNT, about 1908, which, with quite as much explosive power could be melted at a relatively low temperature and cast solid into a mold, in which condition it could be copper-plated, if desired, and rendered impervious to moisture, which, however, produces no deleterious effect on its explosive power or its stability.

Trinitroaniline, a comparatively new invention, was advocated as having higher explosive power than any other stable compound. Stability tests, however, showed that it was affected by moisture, freeing nitric dioxide (NO_2), which rendered it unsuitable for storage aboard ship or in torpedo warheads, or in mines where the protection against moisture is impossible. The adoption of this explosive was urged on the ground of its utilizing a surplus product not heavily taxed by the demands of the war, *i. e.*, di-nitrobenzol, a substance of quite extensive commercial production. As the manufacture of this explosive had not progressed beyond a large laboratory scale, it was not considered practicable to develop and construct a new plant for its manufacture on the large scale demanded by the war. Dinitrobenzol when treated for its further conversion into TNA emits poisonous fumes, and its further use as a diluent of TNA was objectionable because of the difficulty of protecting workmen from the serious consequences of handling this poisonous compound.

Trinitroxylol, or TNX, was proposed by the du Pont explosives chemists as a substitute for TNT, and to make up the difference due to the expansion of the demands on toluol and other coal-tar products involved in the manufacture of TNT, picric acid and similar high explosives. Xylol is one of the lighter oils accepted in the production of toluene, and its use thus saved a by-product to meet the demands of the situation. This interesting compound was extensively tested at Indian Head, proving to be stable but of slightly inferior power to TNT itself.

This xylol development was one which removed the Navy from any bargaining for its allotment of high explosives from this nation and the Allies. TNX does not cast alone readily except at temperatures too high to be safe but it is used when in a semifluid state—that is of a consistency of heavy oil—when it can be poured. TNT, 40 per cent, and TNX, 60 per cent, was called "Toxyl." The mixture gives the same or equal underwater explosive effect as straight TNT. Amatol was 20 per cent TNT and 80 per cent ammonium nitrate. Amatol was not used in the Navy as a shell filler, only Explosive D (am. picrate), black powder, and TNT.

Another interesting development was an attempt to produce an explosive of the Sprengel class, a mixture of two inert substances, which, when united, would be highly explosive. Experimentations in the chemical section of the Bureau led to the interesting result that a stable mixture of liquid nitric dioxide (N_2XO_4) with benzol produced a (N_2O_4) mixture insensitive to shock and thus provided an explosive for limited purposes. Its explosive power was considerably higher than that of any of the other explosives in use, but difficulties in its use as an explosive for shell filler were encountered owing to the effect of temperature variations. The close of the war prevented the further development of this interesting mixture.

During the war the Navy was represented upon a committee appointed by the National Research Council called the Committee on Explosive Investigation, which committee is headed by Professor C. E. Munroe, one of the best known explosive experts in the country. The Navy was represented on this committee by the officer of the Bureau in charge of the research section. The committee collects and collates all information obtained here and abroad in relation to the manufacture and use of explosives, and this information is placed in shape for use of everyone. It is hoped that this committee will continue during peace.

Depth charges were cylinders known affectionately as "ash cans" with at first 50 lbs. TNT. This charge was not effective, in fact the Germans called them "ticklers." Later the 300-lb. and then the 600-lb. charges were used. The vessel dropping these charges must, of course, be some distance away not to be hurt by the explosion. The commander of one of our destroyers returning from search duty and having sighted no submarine wished before going in to port to test the firing mechanism of his depth charges. He steamed too slowly and a leaky condenser resulted.

Large quantities of TNT were required, amatol was not powerful enough, so TNX was adopted by the Navy for use in depth charges. These weapons, after the United States got into the war and saw that there were plenty of depth charges available, were the most dreaded of weapons by the German submarine commanders. The American and British depth charges differ in several particulars. The American depth charge is fired by means of hydrostatic pressure, while the English type fires by seepage. The American firing mechanism was installed inside the cylinder or "ash can" so that it could not be damaged accidentally, while the British mechanism protruded several inches beyond the cylinder head. The American depth charge was also provided with a safety chamber which held a detonator in such a position that until the charge had dropped some distance into the water the explosion of the detonator could not fire the charge. It is of interest that the Germans complained of the excessive violence of the depth charges and it is believed that this was because of the fact that TNT was used in the American charges while amatol had been used in foreign-made charges.

The American mines also, including all those that were planted in the North Sea, were loaded with TNT, although the replacement mines were being loaded with toxyl. These mines, after the planting of the Northern Barrage by American vessels, were mentioned by every German submarine commander captured, and seem to have taken the place of depth charges as the instrument of destruction most dreaded.

The chemists' knowledge came into place in the development of detonators and fulminates for explosive purposes.

Here, gentlemen, is a problem in which the Navy is vitally interested and which is awaiting the solution of the chemists and physicists to-day—the development of a new source of motive power for the Navy's underwater automobile torpedo.

In order to explain the problem a short description of the torpedo is required.

The present type of torpedo is propelled by a gas turbine. The nature of the gas is partly steam, and the rest the products of combustion of burning alcohol in air. A general description of the torpedo generating plant is as follows: A container for compressed air under high pressure, a container for fuel (alcohol), and a container for water. Air, fuel and water are admitted to a superheater or boiler simultaneously. The alcohol burns and the water is used to reduce the temperature of this reaction, so that the resultant mixture of steam and products of combustion enter the turbine nozzle at about 1500° F. as the motive fluid.

The weight within reasonable limits is determined and the combined volume of the three containers is fixed. Therefore the results of such a system depend upon, first, the efficiency of the boiler, or superheater, to realize the maximum efficiency of the oxygen contained in air and produce the most efficient gas at the turbine nozzle, and second, the results depend upon the turbine and mechanical efficiency of the mechanism to turn the motive fluid into useful work. The efficiency of the boiler system has been developed to a point where any great gains in efficiency can no longer be expected. From time to time minor increases may be discovered and made. The mechanical end of the torpedo is now very highly developed, and is quite efficient, and no great gains in efficiency can be expected here. In other words, for the given weight and size the present torpedo may be considered to be at its maximum efficiency.

The Navy and Bureau are confronted with the problem of developing a torpedo of vastly more range than the present type. This problem calls for a radical change in method of carrying energy aboard the torpedo, for into the present size and approximately the same weight must be stored two to four times the present amount of energy.

Several methods have been proposed and sufficient study has been made to show that they are not developed or practical as yet to base any assurance of a solution on. The substitution of pure oxygen for the air, the substitution of hydrogen and oxygen for the air, the use of motorite, aluminum oxide, thermite, etc., have been suggested to the Navy. Some of these may eventually give a solution, but at present all of them lack development, and very little is known about their properties with reference to control of the reaction, safety, and general use and handling.

The Navy was interested in the building of a plant for the fixation of atmospheric nitrogen because of the fact that in December 1917, January, February, and March 1918, the importation from Chile of nitrates had been but one-half the consumption of that product for war uses by the United States and the Allies. This was one effect of the submarine warfare which caused a shortage of ships. The Navy back in 1909 had recommended the establishment of such a plant but it remained for the Army first to establish one, in accordance with the recommendations of the Nitrate Commission, at Sheffield, Alabama. The Navy proposed to erect one exactly similar to Plant No. 1 at Sheffield, that is, one following the modification of the Haber process developed by the General Chemical Company whose president is the president of this SOCIETY, namely, Dr. William H. Nichols.

The Navy's plan was to manufacture an amount of synthetic ammonia from the oxidation of which there could be made sufficient nitric acid to handle the daily output of 100,000 lbs. of powder, which is the capacity of the Navy's plant at Indian Head, Md. The project was given up shortly before the armistice was signed.

In fuses, the field of development is by no means exhausted. The time fuses used against aircraft do not perform satisfactorily as yet because in the rarefied air at high altitudes, the time train refuses to burn uniformly. Mechanical fuses are being tried out but are not suitable as yet. The shock of discharge so often deranges the mechanism. This then is a problem between the chemist and mechanic.

And, speaking of aircraft, the development of helium, or its trade name "Argon," is pertinent. Helium for use in balloons and dirigibles in place of hydrogen was first proposed by the British, who were, however, without a suitable source or process from which to secure a supply. It was known that natural gas from certain gas fields in the United States contained helium, and, on the entrance of this country in the war, the British proposed that we undertake to find a process by which the helium could be extracted from this source. A study of the various processes of gas reduction was made and one process (Linde process) was decided upon as being suitable for adaptation to the extraction of helium from natural gas. A survey of existing gas fields was made and it was found that the gas from the Petrolia field in Texas contained the highest percentage of helium. Control of this field was secured and a plant for producing helium put into operation. This plant has a maximum production of 30,000 cu. ft. per diem. The gas from which the helium is extracted is not lost in the process, but most of it is returned to the lines, the gas being metered going in and coming out and the Government merely paying for the difference. While the cost of helium so produced is higher than the cost of hydrogen, safety considerations plus the loss of balloons through ignition of the hydrogen more than offset any increase in cost. Undoubtedly, the production of helium in quantity is a step forward in the art of ballooning and is a triumph in chemistry. In using this argon or helium, it has been decided to adopt a mixture composed of 85 per cent helium and 15 per cent hydrogen, which should give a lifting power of 70.18 pounds per 1000 cu. ft. of gas. Such a mixture then gives 93.4 of lifting power of hydrogen, and yet is practically non-inflammable.

Passing to metallurgical chemistry, I note that we demanded high-quality steel in all our forgings and in such quantities that the number of firms capable of producing such steel was increased five times. In future, there will be no difficulty in purchasing high-grade steel. Perhaps we benefited the designer and the country more than we did the steel makers. No new compounds or alloys were found that increased the strength of steel. The point is that the improvement in quality appears to depend upon scientific heat treatment. This seems to be the only real line of advance at present.

One of the most interesting fields of investigation, and one in which extensive experiments have already been made, is the erosion of guns. Into this problem enters the metallurgical chemistry of the steel or alloys of which the gun is constructed as well as the chemical products of explosion, their temperature and pressure. The ultimate cause of erosion seems to lie in the high temperature of gases as well as their dynamic effect when moving with the enormous velocities resulting from the explosion.

Metallurgists are now endeavoring to find an open-hearth steel which will be sufficiently strong and yet possess great non-corrosive and non-magnetic properties, such a steel for use as periscope tubes.

Much work has been done with zirconium steel but no uniform results are obtained. Some melts called "freak" have resulted in 315,000 lbs. tensile strength, 290,000 lbs. elastic limit, 45 per cent reduction in area and 15 per cent elongation. One-quarter inch steel plates for light armor do not yet resist the rifle bullet. Nickel zirconium gives a higher recovery of zirconium than does a silicon alloy.

Among the interesting service which chemistry rendered this Bureau was that of economizing fuel by establishing a plant for the extraction of gasoline from the natural gas fuel, as is used at Charleston, W. Va.

When firing guns, often there are left in the bore deposits of copper from the rotating bands of the projectiles, due to the scouring away of this band by the metal of the gun linings. These deposits tend to make the gun inaccurate and might some time so constrict the bore as to result in the bursting of the gun. An alloy composed of zinc 5 per cent, lead 25 per cent, tin 70 per cent, or thereabouts, is introduced into the gun with the firing charge so that it is vaporized by the heat of the burning powder and while at a high temperature unites with the deposits of copper in the rifling. These alloys that are formed by the union of copper, lead, zinc, being softer and less tenacious than copper, are scraped away by subsequent shots, thus freeing the gun from objectionable copper deposits. Chemical and metallurgical investigations have indicated the most suitable alloy for this purpose.

One interesting aspect of the late war from a chemical standpoint was the great increase in pyrotechnic devices, such as smoke-producing apparatus, marker-shell, pyrotechnic signals, illuminating or star shells, smoke shells, incendiary bombs, and all type of signal devices. In respect to this class of apparatus, all countries were in about the same state of unpreparedness when the war began despite the fact that devices of this nature, though in simpler form and smaller variety, have been employed in warfare from time immemorial. The manufacture of fireworks and pyrotechnic devices was based principally on empirical methods and there was no information at hand on which to base new developments. Accordingly each new device called for a chemical investigation.

The star shells already spoken of are well along, but they function satisfactorily for only a part of the time. As used abroad they would be fired only by a vessel when using reduced charges in guns. This was a restriction our Navy was not prepared to accept. The chemical part of the shell is the illuminating mixture and the methods adopted to insure its lighting.

The Navy is also desirous in a pyrotechnic way of obtaining a compound or mixture which when placed in a shell will, upon its bursting under water, cause a vivid red smoke, and another to cause a brilliant yellow smoke to float off. White smoke is produced by black powder, black smoke can be produced by detonation, or another chemical mixture not found yet. These are needed for use in distinguishing fall of shot from the various turrets in order to discover errors in gun fire.

During the war, one of the methods which the merchantmen used in order to hide themselves from submarine attacks and thus escape was to produce a cloud of dense smoke and, when under this cover change course and thus elude the submarine. This is spoken of often in the blockade runners of days in the civil war where wood high in pitch and rosin was freely introduced into the furnaces of blockade runners, in order that they might escape under cover of this smoke.

As another pyrotechnic device we have the Mark I smoke box, an emergency production following British specifications, and containing a smoke-producing mixture composed of sulfur, saltpeter, pitch, orpiment, bicarbonate of soda and minor quantities of other chemicals. This mixture proved to be unstable and caused a few fires. When examined critically, it was seen that there were many inconsistencies in the chemical mixture, besides disadvantages in the mechanical arrangement, means of ignition, and so on. It was, therefore, decided to develop a more satisfactory apparatus, and the Mark II smoke box was developed. In developing the Mark II smoke box, which was done at the American University Experiment Station of the C. W. S., many mixtures were investigated, special instruments were devised to measure the obscuring power of the smoke evolved, the persistency and density were noted, and reactions which militated against smoke production were avoided. The mixture finally adopted produces an astonishing amount of dense white smoke of great persistency, and is undoubtedly superior to other mixtures employed for this purpose. Likewise, the Mark I smoke funnel, which was designed to produce a smoke cloud from the ship itself, used white phosphorus as a smoke-producing agent, which while satisfactory in regard to smoke was dangerous to handle aboard ship, was hard to control and caused fires. The Mark II smoke funnel, mainly the product of the Bureau of Mines, which superseded the Mark I, produces smoke by spraying together ammonium anhydride and silicon tetrachloride which are carried in drums. The silicon tetrachloride drums are charged with carbonic acid to force the liquid out of the spraying nozzles. The result is a dense white cloud of the atomized ammonium chloride which is extremely persistent, entirely harmless and can be controlled at will. Another method of forming a smoke screen is by spraying oleum, or fuming sulfuric acid into the funnels, where it is vaporized and blown out in a dense white cloud.

Hundreds of thousands of signals—rockets—were manufactured for use as distress signals and recognition signals. They employ colored smokes as well as colored lights, the formula being developed only after extensive chemical investigation.

The first German noxious gas attack was made in April 1915 against Canadian troops and was composed of clouds of chlorine gas. This type of warfare had been forbidden by the Hague Conference and the Allies did not expect the Germans would use it. From that time offensive and defensive methods of gas warfare were continuously developed by the Allies. A certain amount of speculative interest was aroused in the United States by this mode of warfare, but it can be said that our acquaintance with the subject dates from our entrance in the war.

You may remember that it was a German by the name of Count von Ostwald who prevailed upon the Kaiser and military authorities to adopt the use of noxious gas in this war. This Count was among the 1000 foreigners who were members of your SOCIETY and I notice that he was expelled. I had the pleasure of lunching in a fine house at Coblenz belonging to a Count von Ostwald (said to be the one) in April, with General Dickman, who was then using it as the headquarters for the 3rd army of the A. E. F.

The Navy was represented in the membership of the original commission that chose the site of the American University near Washington for gas or air research and this commission was one that vested the work and responsibility for the development primarily in the hands of the Bureau of Mines, your Secretary having very much to do with the remarkable success therein made by this Bureau. That the Army, with the great help of the Bureau of Mines, was able, with this late start, to reach at the time of the armistice, a point of development of gas warfare which equaled, if not surpassed, that of all other combatants, speaks volumes for the chemists and chemical engineers and is one of the real achievements of the war. The Navy also faced the possibility of gas warfare, and developed a gas mask and gas-shell filler suitable to its needs. The main point of difference in the Navy gas mask is that the canister is carried on the helmet in such a way that the ears are uncovered, permitting head telephone sets to be used, and at the same time more freedom of action in loading and pointing the guns is secured. The Navy gas-shell filler is designed to meet the special conditions of naval warfare. In connection with gas shell in naval warfare, it is interesting to note that in the Battle of Jutland, both the German and British thought that the other side had employed gas, but it was subsequently shown that neither side had actually used gas, but that the toxic effects noted had resulted from the inhalation of fumes from the explosive shell fillers.

To be on the safe side the Navy then had to develop gas shell. Our conditions are quite different from those of land warfare. Our prime mission is to sink the enemy's vessel; therefore all shells must penetrate armor. These are then made of a very high grade of steel, thick-walled, and require a large explosive charge to burst them. Thus this limits space assigned noxious gas. At first an unsuccessful search was made for one that was also explosive, then we got the best you chemists could give us, which was said to be the best or worst in the world—another testimonial of the chemists' ability. The Navy thus had and had loaded before the war ended shell containing two different types of most efficient noxious gas which released in a confined ship compartment would be drawn into the ship's ventilating system and thus distributed throughout the ship, greatly to the discomfort of the personnel inhaling it.

During an encounter with some German destroyers, the "Botha" went through a smoke screen laid by the Germans, as the result of which the crew of the destroyers were taken with violent sneezing and hence the Germans are credited with having used sneeze gas in this screen.

Our relations with chemists have been so advantageous and so happy during the war that the Navy earnestly hopes you gentlemen will not lose interest in us. You note there are plenty of problems remaining.

Doctor Herty has suggested that military and naval schools be given talks explanatory of what the mission of chemistry is and its application to all problems made clear. If students could be made to realize the practical use of what they study, how much easier it would be to keep them enthusiastic. This plan I hope may be carried out. We trust that the post-war days will find its officers and the members of this great organization closer together than did the pre-war days, and I believe that the Navy will meet your offers of assistance more than half way and gladly utilize your research power.

STEAM POLLUTION AND ITS RELATION TO THE CHEMICAL INDUSTRIES

By Earle B. Phelps, Hygienic Laboratory, Washington, D. C.

The relation of steam pollution to the chemical industries is twofold. Many industries require for their purposes water supplies of good quality, and most of them produce wastes which if discharged without treatment into the water courses tend to pollute those waters to a more or less harmful degree.

Pure water has been defined as a water that contains no harmful or deleterious substances with respect to the purpose for which it is to be used. In accordance with this very practical definition typhoid germs constitute an impurity and calcium salts do not in the case of a drinking water supply, while the reverse is true in the case of a boiler water. The various industries have their special requirements in the matter of undesirable constituents in the water supply. Hard waters are objectionable for boiler purposes and for the textile industries, while the brewer used to demand a certain degree and quality of hardness. Iron salts and organic color and all suspended matters are especially distasteful to the maker of fine papers; the laundryman sees wasted dollars in calcium salts, while the gas house can put up with anything that is wet and will run.

As long as the manufacturer has to deal only with the natural impurities of the water supply he can first of all choose his supply with discretion and then, if necessary, treat it by some simple purification method designed to meet the special requirements of his case. With the growth of industry, however, and the increasing joint use of streams for the purposes of water supply and waste disposal, conflicts of interest arise which, unless rightly treated at the start, may lead to litigation, unnecessary expense, serious economic loss, and often the actual destruction of an industry. The first and best remedy lies in the proper appreciation upon the part of the manufacturer of the iniquity and menace of stream pollution It is good law as well as good economics that a riparian owner is entitled by right to any proper use of the stream that flows by his land, with due regard to the exercise of a similar right on the part of lower riparian users. This dictum of the common law has been interpreted by the courts in some extreme instances to mean that there shall be no appreciable reduction in the flow or alteration in the quality of the water by any user. Such extreme interpretation, however, would of itself defeat the very purpose of the law by prohibiting almost every valuable use of the water. In the main, the courts hold that there must be no serious or unreasonable pollution such as would materially damage another and with due regard to the character of the stream and of the uses to which it has customarily been put.

State legislation has not always been based upon a similar application of the law of reason and in some instances has worked unnecessary and unjustified hardship upon the industries. In general, however, the states have lagged behind rather than pushed ahead in good engineering practice and scientific advance along these lines. One phase of the state control of stream pollution, which although of especial interest to he manufacturer has generally been overlooked by him, ought to be referred to here. It is the fact that in most states this entire matter comes under the administrative activity of the public health officials, who likewise initiate or assist in framing the various legislative enactments. Manufacturing and other interests have in the past exerted merely obstructive influence and have in certain cases defeated good public health legislation because of the unnecessary breadth and generality of the proposed law. The public health interest in stream pollution, where it exists at all, is necessarily paramount, and frequently controlling, but in few cases is it so great as to be unique. It is believed that the drafting of anti-stream pollution legislation and the administrative control of streams should be placed in the hands of competent boards similar to the British "River Boards" upon which there shall be adequate representation of hydraulic, sanitary and chemical engineers, and a minimum of medical representation.

The problems of the scientific control of stream pollution are problems of engineering, chemistry and biology. Of immediate and pressing interest is the fixing of standards of permissible pollution, which will comply with the common law conception of reasonable use and develop the maximum advantageous use of the streams. Such standards will necessarily vary in the individual cases and have already been fairly well developed in the case of domestic water supply. No better illustration of the inadequacy of the present system of state legislation could be cited than the fact that in general state laws place a uniform blanket restriction upon the pollution of all the waters of the State, regardless of their size, character or uses.

Of especial interest to chemists is the other great problem of stream pollution, namely, that of remedial measures. The treatment of industrial wastes may in certain cases be worked out along the line of biological oxidation, which has been developed to such a high degree of efficiency in the case of domestic sewage; but as a rule, and this is especially the case in the chemical industries themselves, chemical methods of treatment are required.

The problem is, of course, specific for each industry, but there are certain general fundamentals. A satisfactory process may involve clarification, neutralization of acidity or of excessive alkalinity, decolorization, deodorization, or any combination of these. As a rule dissolved substances that are neutral, colorless and odorless are unobjectionable in moderate quantities. At times, however, it becomes necessary to remove such substances if they are distinctly poisonous, as in the case of arsenic compounds, if they produce a taste in a water used for domestic purposes or by stock, or if they are putrescible.

For clarification there are available the ordinary methods of the chemist: sedimentation with or without the addition of chemical precipitants or coagulants, or filtration, gravity pressure or centrifugal. Neutralization of excessive acidity or alkalinity should really be classed with the removal of other objectionable dissolved substances. These all constitute simple chemical problems which need no extended discussion here. It may be well to point out, however, that in the majority of cases the protection of fish life becomes the controlling factor in the matter of the discharge of acids, alkalies or toxic compounds.

Decolorization is especially indicated in the treatment of the wastes from dye manufacture and from textile dye-houses. While it may be justly urged that because of its extreme dilution this type of pollution works the minimum of harm upon a stream, it must in fairness be admitted that the appearance of a stream constitutes a considerable part of its value to a community. It is, indeed, the fact that, next to pronounced odors of putrefaction, no effect of pollution is more quickly resented by the public than a marked and continuous discoloration. Successful treatments have not yet been developed. For the treatment of small volumes the writer has employed filtration through charcoal. For certain dyes chlorination has also been found satisfactory, although somewhat expensive. This phase of the subject represents an interesting unsolved problem of a strictly chemical nature. Contributions toward its solution would be of the greatest practical value.

Deodorization is a still more special case and fortunately is demanded but rarely. In the writer's experience the danger of pollution of a drinking water supply by the wastes from a plant in which several nitration processes were being carried out necessitated a study of the possibilities in the matter of odor removal. In this case the problem resolved itself into one of the virtual destruction of the offending compounds or else of their removal by steam distillation or treatment with charcoal. That this is a phase of the problem well worthy the attention of industrial chemists is illustrated by the fact that the United

States Government found it necessary to advise the shutting down of a large phenol plant working on government orders, because it seemed impossible in any other way to relieve the very slight pollution of the water supply of a large city. The actual amount of phenol present in this water was too slight to taste but after the water was disinfected by chlorination a taste was imported to it which aroused serious resentment throughout the city.

This illustration also serves well to show the influence of the specific uses of a stream upon the character and extent of the permissible pollution, and the accepted principle of preferential use in the case of conflict.

A fact of especial interest to the manufacturing chemist in connection with studies on the treatment of industrial wastes is that such studies may frequently lead to the recovery of valuable by-products. The early history of hydrochloric acid is, perhaps, not as well known to the present-day student of stream pollution as it should be. This important commodity was at one time an extremely undesirable waste product, which was disposed of only at great expense and under continuous pressure from legislators and the courts. The necessities of the case led to investigation and ultimately to the development of a market for the acid. A similar history might be recited concerning many by-product recovery processes, one notable case being that of gas-house wastes.

In just so far as the chemist is a broader man than the chemical manufacturer, so this problem of stream pollution has to him a broader significance than is included in its legislative or remedial phases. It is a part of the problem of the maximum development and utilization of our waterways. It is bound up with such matters as water power, navigation, public water supplies, sewage disposal, the fish and shell-fish industries, scenic beauty, and the recreational activities of the people. The subject of waterways and their development and utilization is one of the important economic subjects now before us. It is broader than its public health interests and the continued control of stream pollution matters by health authorities, having no appreciation of the magnitude or diversity of the problem, cannot long be tolerated. The subject is broader than state jurisdictions, for the great rivers and river systems of the country are interstate. It is essentially a Federal problem calling for the broadest possible viewpoint and especially for uniform treatment. Of what avail, for example, is a law for the protection of the Ohio River, enacted in the state of Ohio, when the communities of Kentucky, just across the stream, may pollute without restriction. An economic discrimination would in fact be imposed upon a manufacturer in Ohio in favor of his business rival across the stream. These and kindred shortcomings of state control have actually delayed the progress of the whole movement, and, as in the case of Ohio, resulted in the exemption of an interstate stream from the operation of an otherwise fairly satisfactory pollution law.

The present writer has previously suggested and wishes here to emphasize the desirability of Federal control of stream pollution under conditions that permit of adequate scientific study of the problems involved and of correlation of these problems with those of public health, navigation, fisheries, and all other matters related to waterways. To this end there might well be formed an interstate Waterways Commission, such as has already been proposed by a committee of the American Society of Civil Engineers. That committee has quite naturally considered in greatest detail the requirements of navigation and water power and has not fully presented the importance of Federal control over the public health and industrial phases of stream pollution. The former is in good hands and will not be neglected. It would seem, however, to devolve upon the membership of this Society to keep advised of these developments and see to it that any Federal agency that may in the future be created for the general control of waterways shall take proper account of the problems of industrial wastes and their disposal and of the importance of protecting streams from pollution which will affect them adversely with regard to their use in the chemical industries. It will also be of ultimate benefit to those industries if the chemists and the chemical organizations of the country lend the weight of their influence, whenever they may properly do so, in favor of the centralization of stream control under some form of Federal authority.

THE CHEMICAL LABORATORY AS A PUBLICITY FACTOR

By Robert P. Fischelis, Technical Department, Matos Advertising Co., Philadelphia, Pa.

Not long ago the chemical laboratory was considered by many industrial concerns merely as an expensive luxury, and while this viewpoint may still be held by a very few concerns, it has largely been supplanted by genuine respect for the accomplishments of the control and research laboratories directed by chemists. American industries are convinced that the chemist and the chemical laboratory are valuable assets, that they have enabled the industries to develop new products, make standard products more economically, find outlets for by-products, eliminate waste, and have helped to place industries on a more substantial foundation.

Unquestionably, the world war has been a marvelous stimulant in arousing the public interest in chemistry. Our newspapers and magazines have been filled with stories of the wonders of chemistry and the average layman is to-day more familiar with the place of chemistry in the sphere of American industry than he ever was before. This is to the advantage of the industry and to those connected with it and this advantage must be held if our country is to remain a world factor in the field of chemistry.

Undoubtedly, the chemical laboratory will play even a greater part in the industries from now on and its place with respect to other subdivisions of business organizations will depend largely upon the effort, personality, and accomplishments of chemists.

Advertising men have their ear to the ground and know the trend of public thought and opinion. They direct their advertising along the line of least resistance, that is the line along which the public has already been educated to think. Those who are engaged in advertising the chemical industries to-day are in a position to take advantage of the vast amount of education that has been carried on by the public press. Due to these efforts, the public no longer looks upon chemistry as a dry, uninteresting subject and one to be avoided. There has been a transition from a feeling of indifference toward this science to one of intense interest. The advertising man will take advantage of this transition. If there is anything "chemical" about any business which lends itself to popular publicity, it will surely be made use of in promoting the sale of merchandise.

It seems almost paradoxical to state, in an address to chemists, that the chemical laboratory should receive greater attention on the part of the advertising and sales organization of the businesses with which they are associated, yet a glance over the advertisements in various publications will convince one that such reference is not at all out of order. There was a time when the chemical laboratory was considered the least important place in the industry, as far as sales and advertising were concerned. To-day the laboratory is continually being sought out by the wide-awake advertising and sales manager for talking points and specialized information about products. When the question of discontinuing a research laboratory came to the attention of the management of one of our large corporations, not long ago, the advertising manager offered to pay the expense of the laboratory out of his advertising appropriation because he considered it the most valuable asset, from an advertising point of view, that the firm possessed. This is getting to be the attitude of most wide-awake business men and it should be fostered on the part of the laboratory man.

The AMERICAN CHEMICAL SOCIETY is spending considerable money, through the A. C. S. News Service, to disseminate knowledge regarding the science and art of chemistry throughout the country. This is of benefit to every one connected with the industry and the ground work thus performed for the industry as a whole offers an excellent opportunity for follow-up work by large commercial institutions in the interests of their own products.

While the newspapers are ready to accept general publicity about chemistry in their editorial and news pages, these pages are not open to the advertising of specific articles, but the advertising pages of these papers are of much greater value while the news and editorial pages are carrying chemical stories. The two go hand in hand and the chemical industries, while profiting indirectly from the news service, cannot hope to profit directly without making use of the advertising pages. Furthermore, public interest which has now been aroused in behalf of chemistry cannot be maintained unless the application of chemistry to every-day life is kept before the public in new and varied form and this can only be done through the advertising pages of the magazines and newspapers of the country.

There has been a general feeling among chemists that their products must be advertised through the technical press. Chemical and other trade journals have their place, of course, but when an advertising medium is to be selected, one must consider the persons who are to be reached and sold. The question is not how much circulation has your paper, but rather who reads your paper? Is the purchasing agent, superintendent or president of the concern, to whom you want to sell chemical apparatus, quantities of chemicals or other merchandise apt to pick up a technical paper and come across your announcement and ponder over it, or is he more apt to be attracted to a less technical announcement appearing in a newspaper or magazine which he is apt to read during his leisure hours when your message, if properly presented, will have a chance to sink in? This is not mentioned to disparage advertising in trade journals, because the careful buyer consults his chemist before he buys anything for technical use, that is what he has his control and research laboratory for, and when he speaks to the chemist of a certain type of equipment or product which has been called to his attention, the chemist must be able to answer by having at his command information that is drawn largely from the advertising pages of the technical press. Few concerns in the chemical field have thus far added the lay press to the technical press as a medium for announcing their products, but those who have taken the step are continuing such advertising. What further proof is needed of its effectiveness?

Advertising is largely a work of education, in fact, pure advertising is nothing but education. It is the education of the public to the use of something new. As soon as competitive brands of the new product appear, the advertising takes on a sales aspect. That is to say, it not only educates the public regarding the use of a new product, but also speaks of the superiority of a given brand of that product. This is where the chemical laboratory has a wonderful opportunity to show its usefulness to the business organization as a whole. Who but the chemist can pick out the fine points of superiority in quality of one paint over another, the greater value for some purposes of a pig iron which contains vanadium over one which does not, the superiority of one source and kind of asphalt over another, the greater value of certain chemicals for specific uses over the same chemicals which, though quite as pure, may not have the same physical characteristics? These are points which even the most imaginative advertising writer, without a knowledge of chemistry, would never think of, and yet they are so much more telling in their business-producing value than the products of the imagination of the advertising writer, that the advertising man will recognize their value in a minute and put them to good use.

It is generally recognized that the outside point of view or the customer's viewpoint is absolutely essential for the success of any business. The chemist in the past has confined his thought to the laboratory. His point of view has almost without exception been an inside point of view. He has seen the laboratory day by day and watched its increasing importance to the plant, but as an insider he felt that the laboratory was a thing apart from the general organization. This feeling no longer portrays the attitude of the modern chemist. He has seen the light, and while the chemist still deals largely with atoms and molecules and the business man deals in dollars and cents, recent events have pointed out very plainly that our success in building chemical industries requires a combination of atoms and molecules with dollars and cents. Continued publicity, general and specific, is the catalyst needed to bring about this very desirable reaction.

SYMPOSIUM ON ANNUAL PATENT RENEWAL FEES

Papers presented before the Division of Industrial Chemists and Chemical Engineers, the Division of Pharmaceutical Chemistry, and the Section of Dye Chemistry at the 58th Meeting of the AMERICAN CHEMICAL SOCIETY, Philadelphia, September 2 to 6, 1919.

AN ANSWER TO THE PROPOSAL OF ANNUAL PATENT RENEWAL FEES

By EDWIN J. PRINDLE, Chairman, American Chemical Society Committee on Patent and Related Legislation

I desire to submit the following reply to the open letter of Dr. B. C. Hesse, proposing annual renewal fees for United States patents as the price of their continued validity. Before taking up the precise question proposed by Dr. Hesse, I wish to state that I am quite as much opposed to Germany's peaceful penetration and quite as desirous of seeing her prevented from using unfair methods as he can be. We should, however, consider any such proposal in the light of all its reactions, as well as of the one purpose in view, and its effectiveness to accomplish that purpose.

Any amendment to our patent law should conform to the fundamental purpose of that law; and that purpose is to secure the production of inventions. The assumption and the fact are that inventions would not ordinarily be produced if it were not for the inducement of the monopoly provided by the patent system. Under the stimulus of that inducement, inventiveness was first developed to any considerable extent in the United States, and it has become much more common here than elsewhere, so that we lead the world in the volume and importance of our inventions. This has not been due to any natural difference, because we are all descended from Europe.

From the standpoint of the public (which is the one which must be considered), it would be ideal if inventions would be produced without any patents and were free as soon as made, but experience has shown that under these conditions very few inventions would be produced. Neither an individual nor a corporation can afford to spend the time and money and incur the overhead expense usually necessary to produce an invention of any value, unless he is assured of an opportunity to reap a return directly or indirectly from a monopoly of the invention.

The inventive faculty has been slowly developed, and any change in our law which decreased the incentive to invent would cause it to atrophy. This condition could not be corrected by a mere restoration of the law, for the same slow process of development would have to be gone through with again for many years. Experiments are, therefore, dangerous, and it is necessary to be sure before any action is taken.

The path which the inventor must travel before he can reap any return is already so difficult that many doubt that it is worth while to make inventions. Added to the time and expense of development of the invention is the question whether it really will stand when used under the stern and unsympathetic conditions of commercial requirements, or will have objections greater than its advantages. Capital must be interested at a sacrifice of a portion of the invention. The danger must be faced that the search in the Patent Office will develop some earlier patent or publication showing all or a vital part of the invention to be old and, therefore, unpatentable. Perhaps, one or more interferences must be fought in the Patent Office with other claimants of the invention. After the patent is obtained, if the invention is good, suits will have to be fought to establish the validity of the patent and to demonstrate that it cannot be safely infringed. The inventor would, therefore, seem already to have all the discouragements he is likely to face and still make inventions.

The Patent Committee of the National Research Council has taken the position that the incentive of the inventor should be increased, rather than diminished, and its report to that effect has been approved by this SOCIETY and by many other scientific societies and by several of the largest trade organizations.

Let us consider what the effect on the incentive to produce inventions would be, of the proposal to require the payment of annual renewal fees under penalty of forfeiture of the patent.

I wish parenthetically to observe that the paper under discussion contains a fundamental error in the statement that

> "an inventor who allows his patent to lie idle transgresses the spirit underlying the patent system. He is reserving to himself a field of endeavor which he has agreed to exploit and is not exploiting and by his reservation he prevents its exploitation by others and thus retards progress."

The Supreme Court of the United States, in the Continental Paper Bag Case, has decided that the patent law does not require the inventor to work his invention, but that, on the contrary, he may not only refrain from using it himself but can prevent anyone else from doing so during the life of the patent, saying that such is the price which the public has agreed to pay to the inventor as an inducement to make the invention and to give a full disclosure of it to the public, in order that the latter may know how to use it and be free to use it forever after the expiration of the limited monopoly to the inventor. Therefore, the proposal to require annual renewal fees is not justified insofar as it is for the purpose of compelling the inventor to perform a supposed duty of working his invention, for the law neither imposes nor implies any such duty.

What, then, would be the effect of these annual renewal fees on the incentive to invent?

First, the taxes impose a burden which many individuals and corporations would hesitate to face. Many of the most important inventions have been made by poor or comparatively poor inventors entirely on their own financial resources. And if, after having obtained their patents, they would still have to pay a series of annual taxes totaling a possible $550, and which in no way aided the exploitation of the invention, many of them undoubtedly would not attempt to make inventions.

There is a large class of small inventions, which are not of enough merit to affect the price of or control competition in the article to which they relate, and so do not bring their inventors any substantial return, and yet these inventions, even when never getting beyond the stage of being patented, occasionally lead the way, step by step, to a point of view from which a really great advance is made. They are thus of importance, and yet the proposed renewal fees would particularly discourage the making of such inventions.

The possibility of overlooking to pay the renewal fees, and of thus losing all of the time and money which had already been put into the invention and patent and all hope of future return, would act not only as a deterrent to the inventor but to any purchaser as well.

Many an invention is ahead of its time and the commercial art does not become ready to use it until the later years of the patent—when it may become very valuable. Also, an apparently trivial invention may, by the unforeseen development of the art, become of substantial or prime importance. If annual renewal fees were required, the inventors, in such cases, would often, and I think usually, have allowed the patent to lapse early in its life, resulting in a feeling of resentment in him and in others which would not tend to increase the production of inventions.

A successful invention is often attained only after development extending over a long period and protected by a considerable series of patents which as a whole are necessary to protect the final invention and are, therefore, equivalent only to a single patent. Yet, if the proposed annual renewal fees were required, an intolerable burden would be imposed on the inventor and he would be paying these multiple taxes for much longer than the life of one patent.

Similarly, it is occasionally necessary to make auxiliary inventions, or inventions necessary to enable the main invention to be manufactured or used, and here again both the number of fees and the period over which they would have to be paid would be multiple, both for the single product from which revenue could be derived and the period during which it was ready for sale.

The annual renewal fees would work a discrimination in favor of the rich man and the corporation against the average inventor, for the former could afford to pay them, when the latter often could not.

The effect of requiring annual fees is shown by the fact that comparatively few American inventions are patented abroad, chiefly because such fees are required in most foreign countries, and it, therefore, follows that a great many American inventions would not have been made if only patents requiring annual renewal fees could be obtained here.

If foreign countries had, by their system of annual fees, induced the production of more inventions than has the United States, there would be more justification for introducing them here, but such is far from being the case.

I am, therefore, strongly convinced that the imposition of annual fees, or taxes, on patents would seriously decrease the incentive to invent.

Furthermore, I do not believe the imposition of annual taxes on our patents would materially alter the German advantage under our patents. If a German-owned American patent were of value in suppressing competition here, the Germans would unhesitatingly pay the renewal fees, even if they were much larger than the proposed taxes. If, on the other hand, the patent was so unimportant that the Germans would allow it to lapse for failure to pay the renewal fees, it would be of no advantage to us to be free to use it, for we should not want to use it.

To be worth while, a remedy must be one which will not only effectively check the Germans, but one which will not at the same time injure us—and more than them. The proposed remedy is not such a one.

Since the establishment of our patent system, we have risen from poverty to the greatest wealth and to preëminence in manufacturing, and our labor has been enabled to live on a scale far above that of any other country. It cannot be denied that our patent system has been one of the primal factors in bringing about this happy condition. The sole price (for the Patent Office is more than self-sustaining) has been an unrestricted monopoly to the inventor for the short period of seventeen years of that which was the product of his own brain, and which but for him the public would not have known, and after which period the public has been free to use the invention forever. We need our inventors to keep us not only abreast but ahead of the strenuous efforts which Europe will make as soon as she has calmed down, and, as Marshal Foch has said, to keep us ever ready to meet another scientific war,—a condition which would not only enable us to win that war, if it should come, but would tend to prevent its coming. Desirable as it is to reduce the commercial advantage of Germany in this country to a minimum, let us not take a step which would do us infinitely more harm than her, and that without substantially accomplishing its object.

ARGUMENTS AGAINST ANNUAL PATENT RENEWAL FEES

By Elihu Thomson, General Electric Company, West Lynn, Mass.

I am, in general, opposed to complicating our patent system and establishing bureaus which have to deal with renewal fees, with their armies of clerks, etc., a folly which has grown sufficiently in our government affairs, and which should not be extended in other directions. I do not think that the principle of patent renewal fees is a sound one for the United States to adopt. My chief reason for this, aside from the consideration just mentioned, is that an inventor, whose vision is some years ahead of his time, may take out a patent on an invention which the art is glad enough to adopt after, say, 10 or 15 years. I think that such an advanced idea should, at least, receive protection for the few years of the patent's remaining life, without being penalized in any way when the development has been delayed, or when the art wakes up slowly to the need of a thing which the inventor had seen a long time ahead. In such a case, should he delay patenting, he runs the risk of having some one else step in and get the patent; so that he cannot delay, if he desires to hold the benefits for himself. He must patent within a reasonable time, or undergo great risk of losing the whole, since it is a principle of the patent law that due diligence in patenting must be exercised to confer validity. It must be remembered that there are patents and patents, some applying to some small simple affairs, gim-cracks, as one may say, which can be developed with great readiness and put into use at once. There are also inventions relating to large structures, for example, a steamship or other large engineering work, and it may be years before the inventor (however meritorious his idea may be, and no matter how much he exerts himself) will get the hearing or get the means for putting his invention into practice. If there is any principle which needs amendment in the patent law, it might be suggested that classes of patents should be formed, and the duration of the patent depend somewhat upon the difficulty of exploitation.

The patent renewal fee, while it might not tend to stifle activity for certain classes of inventions, would tend to stifle inventive activity for inventions which require expenditure and a considerable time to introduce. It often happens that an invention has at first a limited application, and as the public gets educated to its advantages, its application grows, and just about the time the patent is to expire there is some chance of its being remunerative.

Such fees would be something of a handicap to an inventor without financial resources. Anything is a handicap which creates difficulty, which acts in any way as a cloud upon the title. Inventions do not differ much from real estate in this respect. Then there is, of course, the possibility that unless proper safeguards are set up, an inventor (when the renewal fee may be due) is either ill, absent, or restricted in funds, and unless due and ample notification a considerable time ahead be given him, he may not be prepared when the time comes for the renewal fees to be paid, unless he has continually kept in mind the matter. He may be too busy to do that. With a clean title he has no such handicap to attend to, no such vigilance to exercise.

The popular idea that wealthy corporations use patents for "blocking" or "protecting" is, to a large extent, false, and where it is done it is a natural procedure, because of the uncertainty of court decisions. It is very easy, after a thing of importance is done, for others to come along with colorable imitations or variations and take out separate patents and then attempt to work them, in spite of the main patent. If the courts were always sure to regard these "steppings-up-behind" in the proper light (which is, that they would never have been made in the absence of the main invention), the case would be different. Where a fundamental and very valuable advance has been made, it is perfectly natural for an individual, as well as a corporation, to take out as many patents on departures from, or modifications of the general idea, as he can afford. In my opinion, this is perfectly legitimate, under the conditions as they exist. It is unfortunate that it has to be resorted to in order to procure that degree of protection which a good patent should confer. If, of course, the decisions in the courts were based upon the opinions of a technical jury, high salaried, composed of the best men that could be found, I think the case might have a different aspect. As it is, there is no such tribunal; the judges have to take what they are told, and it is marvelous that they should get at the real essentials of the case as often as they do. The present method of taking testimony, as compared with that which used to exist in the past, is a great improvement, and tends to the obtaining of just decisions.

As to whether patent renewal fees would tend to open up for development fields in fact, though not formally abandoned by patentees, I would say that I do not think that fields, generally speaking, are abandoned by patentees when there is a chance to pursue them to a valuable result.

Whether the added cost of patent maintenance due to such a system would be sufficient to deter corporations from disclosing their inventions through patents would entirely depend upon the actual cost of patent maintenance. If the cost were nominal, the influence might not be great; if it were large, the effect would be great. Here again, I object to the complications involved, the bookkeeping, the keeping of accounts, the slavery to figures.

The United States inventor has for many years suffered a serious handicap, as compared with the foreign inventor. In some countries it is required that a patentee shall work his invention within a certain period, or the invention is forfeited. A foreign inventor, a citizen of a country making these restrictions in regard to a United States inventor, takes out a patent in the United States, and is not required to do anything. The result is that the foreign country in question gets the benefit of the invention being made free to the public, while the United States manufacturer has to wait for the expiration of the patent to a foreign inventor before he can take up work in the field, even though nothing may be done during the life of a patent by the inventor himself. This is a case where "sauce for the goose is *not* sauce for the gander." It is a great folly which has been many times pointed out. It is a discrimination against the American inventor which should never have existed, and a good deal of the energy spent on tampering with the patent laws might well have been spent in considering the equitable aspects of this question. Surely, a foreign inventor patenting in the United States should be put under similar restrictions to those imposed by his country on United States inventors. Such fees would tend to induce foreign owners of United States patents to forfeit them, just as the foreign fees have induced and do induce United States inventors to forfeit foreign patents in the case where such fees are demanded, or where continuance fees are required. The hardship in this case is, of course, greatest when the man who has made the invention is considerably ahead of his time, when his vision of the future is the clearest, when his imagination as to what should be done teaches him to improve an art, even before the public has any realization of the need of such improvement.

While I do not favor such fees, I think if they were imposed, there should be, at least, a ten-year period free from any fees. The size of the fee is a matter for discussion, and largely depends, it seems to me, upon the invention in question. It is doubtful if the fees exacted should be the same for all inventions. It would be desirable to have them so, but this might work injustice in many cases. Let me reiterate that I think the system as it stands is quite good enough without these renewal fees. It seems to me it would be better to make them uniform, if they were proposed. I am in favor of anything which tends to diminish the grip of bureaucracy upon the people or the industries. It is a growing fungus, which tends to sap the national vitality and divert effort from its proper channels. I am not in favor of experimenting with a system which has worked well in the past and which, if improved, could be better improved in other directions.

I may say, in conclusion, that I am not much in sympathy with the means proposed for diminishing "the grip which foreign—and especially German—inventors have on our domestic industry," because I would take care of that by penalizing the foreign inventor as the American inventor is penalized by foreign patent laws. We have been very foolish and very lax in the past, and unfortunately the outlook for the future is not much better, without some considerable reform. I do not see why our home inventors should be taxed generally to secure the result which could be much more simply secured in another way, without trouble to such inventors.

SHOULD WE HAVE ANNUAL RENEWAL FEES?

By L. V. Redman, President, Redmanol Chemical Products Co., Chicago, Ill.

We begin by assuming that the principle is sound upon which our present patent system is based, namely, that the granting of monopolies and exclusive rights for a term of years to those persons who have new and novel ideas will stimulate invention and discovery. We will not argue this point. We will assume that it is true. Then are patent renewal fees justified?

First let us take up the question, what practice exists in other countries? Other countries have patent renewal fees. It has been urged that since all other countries have patent renewal fees, the United States should have them. There is nothing in this reasoning which is fundamentally sound, as other countries may be and probably are in such financial difficulties that it is necessary for them to have renewal fees in order to have sufficient funds to maintain their government. What applies to a rich country like America may not apply to a poorer country with large national debts. What others are doing is irrelevant in this case.

Patent renewal fees in the United States will be justified if it can be shown that present abuses in our patent system can be thereby eliminated or remedied.

Our proposition, the correcting of abuses of our patent laws by levying a renewal fee, holds good, provided we can show that certain abuses in our present system can thereby be corrected. What are these abuses?

We can hardly expect that any abuses will be corrected by taxing legitimate corporations for practicing their patents. It is obvious that there should not be renewal fees on American patents if these patents are being practiced in this country.

Should a corporation be taxed on patents which are taken out solely to protect the patents owned by the corporation and at present practiced by them? A practice which Dr. Hesse, in the *Journal of Industrial and Engineering Chemistry*, labels as abusive of the patent system is the method practiced by corporations of taking out large numbers of patents which are contingent to their business, but upon which their business does not vitally depend and under which patents these owners do not practice or pretend to practice. Is this an abuse of privilege? We think it questionable whether this is an abuse, even in the aggravated case cited by Dr. Hesse that is, that of the Bayer Company who owned 1200 patents at the time of their transfer from German to American owners.

Fundamentally, a patent is intended to be a monopoly on an idea for a term of years and this monopoly is supposed to stimulate inventive genius. We cannot enter into an argument as to the soundness of this theory. Let us all agree that it is sound, for it is the foundation of all patent systems in the world. What we would like to discuss here for a moment is the question as to whether the taking out of contingent patents by large or small corporations, or individual owners for that matter, is necessarily an abuse? We think not, and our reason is that in order that an inventor may have and maintain the monopoly granted to him by our patent laws, it is necessary that his invention be given as wide and as comprehensive interpretation as possible. He takes out contingent patents which are really an interpretation of his original patent, and are taken out in order to protect what our Government has agreed is right, namely, the monopoly of a new idea. The contingent patents are, in every case, patents which run parallel to the original idea and all the inventor or corporation is doing is providing protection against the possibility of closely paralleled ideas growing up to destroy the monopoly. These parallel ideas, although in many cases patentable, do not change appreciably the number or usefulness of things invented. Consequently, they have no fundamental right to exist as a patent. However, the original patentee in taking out these contingent patents saves himself endless litigation and endless trouble in the courts, and he is justified in doing so, remembering always that the intent of the Government in granting a patent was to give him a monopoly on his idea.

It has been urged that large corporations prevent advancement by buying up and pigeon-holing new and useful improvements in the lines of manufacture in which they are interested. This is an assertion without proof. Seldom do we find a manufacturer or a corporation of prominence who does not recognize the necessity of producing the best possible article in order to prevent competition. It is impossible for corporations to buy their way in leadership if they refuse to take advantage of the new and novel ideas they have originated or purchased. The corporation that buys its supremacy by suppression is in the position of the country which pays bandits to stay away from its boundaries. The fee invites piracy. The corporation is already on its way to decay if it buys patented ideas which are in advance of its present practice and then suppresses the practice of those patents.

Now let us consider those patents which are taken out by patent pirates who prey upon new and useful knowledge without attempting in any way to manufacture or practice under their patents. They take out patents in order to tie up new patented industries. The outstanding abuse of our patent system (which allows very liberal and promiscuous patenting) is the abuse which creeps in, due to the patent pirate, who without attempting to manufacture explores at his desk a new series of ideas which are being patented by others, and, adding at random, without trial or practice, such knowledge as he may possess in the plying of his trade, he takes out accessory patents in the hope that he may be able to complicate the situation to such a degree that the original inventor or corporation owning the basic patents may be compelled to buy him off at a handsome figure to prevent costly litigation. Renewal fees on unpracticed patents will certainly eliminate a great deal of this sort of piracy.

If these pirate patents can be taxed out of existence a good purpose will be served. The elimination of the pirate is the greatest possible improvement that could come to our existing order.

Obviously there should be a non-taxable period beginning with the granting of the patent; it should be sufficient to allow three years as the non-taxable period, after which time the taxable period should begin. A flat rate of $100 per year, no sliding scale, would certainly be the easiest to remember and would be sufficient for the purpose. A sliding scale would not be a tax on the patent but a tax on the memory.

There should also be a period during which a lapsed patent is redeemable. For this we advocate a two-year period. This gives the inventor a total of five years during which time, without cost, he may prepare to manufacture. Certainly if the five-year period is any serious hardship to him the remaining twelve years of the life of the patent will not be of any great value. Five years should be sufficient to enable the poorest to get their processes under way.

Our conclusion of the whole matter, in brief, is this—no taxes for revenue only should be imposed on any patents. Patents which are practiced and operated legitimately should not be taxed, as such taxation is contrary to the principle of granting patents. Accessory patents without renewal fees should be allowed to those who hold the basic patents providing the accessory patent is taken out with the sole intention of preserving a monopoly on the original basic patent, for it must be recognized that the inventor has as much right to protect his monopoly as the Government has originally to grant it. Renewal fees should be levied on unpracticed patents in case it can be shown that the patentee does not propose to and cannot practice his invention because of basic patents which stand in his way.

ANNUAL PATENT FEES IN THE UNITED STATES

By R. L. Stinchfield, Eastman Kodak Company, Rochester, N. Y.

The subject of annual patent fees ought to be first examined in the light of the fundamentals of our patent system. The principal object of this system is to promote the progress of science and the useful arts by obtaining for the public valuable technical information which it did not before possess. Inventors have such information and the public gets it from them by offering patents in exchange for it. In effect the Government says, "We will swap a limited monopoly for a disclosure of your invention." This disclosure (and not the fee) is the inventor's payment for his patent.

But the negotiations leading to the exchange cost money. The official expenses incident to the prosecution of patent applications, while insignificant in proportion to the value of the resulting patents, must nevertheless be borne by somebody. Here is where the fees come in. Their legitimate purpose is to help defray the cost of the Patent Office, each applicant chipping in his share for the examiners' services.

When an inventor thus yields up his nugget of knowledge and contributes his bit toward the running expenses of the Patent Office, he has done all that can be expected of him. He has paid in full, and his patent, for that reason, ought to be equally full—ought to run its entire term. It must be remembered that the disclosure, once made, cannot be recalled by the patentee. Any system would surely be inequitable which would permit the Government to tie strings to its offer when, from the nature of things, the inventor can have none tied to his disclosure.

If annual taxes could be regarded as the consideration for the patent, it would be perfectly just to let the patent endure only in proportion to the taxes paid. But such taxes are not the consideration. They are not what patent systems are maintained for. We do not have patent laws and a Patent Office to collect funds. Science and the useful arts progress on inventions, not on dollars.

Suppose, however, that annual taxes should be imposed, contrary to the spirit of our present American patent system. What good would be accomplished?

Let us first consider those patents which claim inventions that never become of any commercial use or which, having once been useful, cease to be of further service to society. They harm nobody. The public obviously cannot be injured by a patent that prevents it from doing something that it does not want to do. Of course, nobody would pay the fees if an annual tax system were in vogue and such patents would then become legally dead. But they are, for all practical purposes, just as dead under our present system. To enact laws to kill them would be like shooting a corpse.

Next we have patents covering inventions of established commercial value. They will undoubtedly be kept alive regardless of what tax system is in force, simply because it pays their owners to do it. Annual tax laws would not alter their status at all.

It is the same with those patents which control useful inventions which the patentee does not care to use himself or let others use—sometimes called "smothered" inventions. If it pays to smother them, their owners are going to do exactly that, even if annual taxes have to be met. Whatever may be said about the compulsory working of patents (and that is another and larger story) the compulsion in an annual tax is too weak to accomplish such a purpose.

European experience does not prove the contrary. In every important country where annual taxes are required other and more powerful forces are acting to shorten the patents, particularly the "working" laws. After a patent has run three or four years its owner must substantially work the invention in the country granting the patent, under penalty of having it held void. While we sometimes meet with the belief that these working laws can be avoided by inexpensive subterfuges, such is not the opinion of the best European counsel. Actual experience indeed has shown that in France and England an unworked patent can be smashed by any competitor who wishes to do so. Of course, few unworked patents actually get into court. Their owners, knowing that they can be declared void at the will of a competitor, stop wasting money on further annual taxes. Thus non-payment of fees becomes the immediate symptom, but non-working is the real cause of the patent's death. It is unsafe, therefore, to predict success for annual taxes alone, merely because of results contributed to by other causes in European countries.

Inventions that appear practically valueless may unexpectedly become important several years after the patents on them have been granted. An organic chemical of only academic interest may, under stress of war, be used in immense quantities. Under our present patent system the owner of the patent would then reap his reward. Under the annual tax system the patent would become void for non-payment of taxes during the years when the invention was apparently valueless. Thus the public would later reap the benefit and the inventor or his assignees would receive no reward. Undoubtedly the immediate effect would be to get the public something for nothing. But as in every other business, it is to be doubted whether a something-for-nothing policy pays in the long run. The stimulated reaction is too strong.

Undoubtedly an American citizen taking out foreign patents is at a disadvantage relative to the foreigner who takes out a patent under our generous American laws. But annual taxes would not make for complete or even substantial reciprocity, so long as the United States citizen applying abroad is subject to working, compulsory-license, non-importation, and other onerous laws. A cure must be found in some other and more complete way.

Besides failing to accomplish any material benefits, annual taxes would be a burden to the poor inventor, and indeed to many small businesses built on patents, particularly during their earlier years of struggle. The tendency of our patent laws ought to be toward, rather than away from, solicitude for such individuals. The annual tax system will have to promise extraordinary benefits to counterbalance this defect, if it is ever to be considered by the average legislator.

Finally, if fees must be changed, let us slightly increase the present ones, and apply the proceeds toward increasing the personnel of our badly undermanned Patent Office and toward paying its examiners salaries sufficiently large to retain plenty of good men at work so indispensable to the inventors and the industries of the country.

ANNUAL RENEWAL FEES FOR U. S. PATENTS

By Edwin A. Hill, U. S. Patent Office, Washington, D. C.

As a member of the Committee on Patent and Related Legislation I have been asked for an expression of my views on the subject of patent renewal fees.

These views I find are in accord with those of other officials of the Patent Office and of patent solicitors with whom I have conferred upon this matter, and are based upon my own twenty-four years of experience in the Patent Office as secretary to three different commissioners, and, for some years past, as an assistant examiner.

As a general proposition I think the burden of proof rests upon those who seek to change the existing laws. A tree is always judged by its fruits, and it is universally admitted that the fruits produced by our patent system far surpass those of any other system or country. Why then change what is good, and experiment with the more or less unknown? Certainly the reasons therefor should be convincing.

I do not think the principle of patent renewal fees a sound one for this country to adopt. Probably the best argument in its favor is that it would limit the number of patents necessary to be considered when capital is entering the field of industrial production, and must necessarily determine to what extent, if any, it will be dominated by existing patents.

On the other hand, the fundamental principles upon which our patent laws are based, and the trend of the modern court decisions expounding them, indicate the patent as a reward for the disclosure of and subsequent dedication of an invention to the public. We grant the patent as an inducement to the inventor, who, having conceived an idea and succeeded in reducing it to practical form, comes forward and in his application makes such a complete disclosure of it to the public that at the expiration of the limited grant of a 17-year monopoly, the public will have full knowledge of the invention, and be able to use and practice it without further instruction. Any change in the present system which removes, curtails, or otherwise nullifies either in whole or in part this inducement offered to bring about the desired disclosure to the public, is against the fundamental principles upon which our patent laws are based. A recent decision of the Commissioner has gone so far as to hold that in an interference proceeding, where the Office has determined the question of priority as between rival inventors, if the inventor to whom priority is awarded, having made no public disclosure of it, allows his application to become abandoned so that the public will never have the invention disclosed to them, the opposing inventor, though proved in the interference proceedings not to have been the first inventor, will nevertheless receive a patent, because his disclosure to the public is the consideration for the grant, and so when he makes the disclosure he thereby becomes entitled to the grant.

The question then stands about like this: Granting that renewal fees would eliminate some of the patents which might otherwise dominate a given line of manufacture, and which if not so eliminated might cause capital to hesitate about embarking in that enterprise, is it equitable or advisable to remove or diminish any of the inducements which the law now offers to the inventor to make it an object to him to disclose his ideas to the public? My answer to this is emphatically, "No, it is not advisable." The value of the inventions, which, under such circumstances, would never be disclosed, and ultimately dedicated to the public, would much more than offset any advantage which the public might gain by thus occasionally removing supposed obstacles to the investment of capital arising from the fear of possible suits for infringement.

In most cases if broad unexpired dominating patents were found apparently neglected and undeveloped, and upon which no large investment of manufacturing capital up to that time had been based, it would be possible to obtain working rights under such patents at prices far short of what would be prohibitive.

I do not therefore consider the principle of patent renewal fees a sound one and do not think it should be adopted.

The question of additional revenue to the Office derived from renewal fees cuts no figure whatever, for while the final decision to change the law should be based upon broad principles rather than upon the narrower view of increasing the Office fees, it is doubtful whether the income derived from such renewal fees would not be more than offset by the reduction in the number of applications filed, for in my judgment such renewal fees would tend to stifle and restrict inventive activity, and would be a serious handicap to the average inventor. One of the chief advantages of our system over that of other countries, as already indicated, is the reward offered to the inventor as compensation for his disclosure to the public. The practical result of this difference in laws may be measured by the number of patents already granted in this country, a number commensurate with those of all other countries of the world combined, and is also illustrated by the fact that in its manifestation of inventive genius this country stands upon a pedestal apart from all others. When the Japanese government, some years ago, investigated the patent systems of the entire world they attributed the wonderful growth and development of the United States primarily to our patent system, and so modeled their own upon ours.

Many poor and struggling inventors would hesitate long before applying for a patent if faced with a series of fees payable year after year perhaps in increasing amounts, and so would never apply, and thus would never disclose their valuable ideas to the public.

It should not be forgotten in this connection that very frequently inventors are often far ahead of their time so that their patents must be held many years before the time becomes ripe for making a proper commercial development of their inventions. In such cases the necessity of keeping the patent alive from year to year, by a burdensome system of renewal fees, would be a very serious handicap upon them and would in many cases postpone the time of filing of their application, leaving the inventor the chance of losing his rights to some later rival who was ready to assume the burden and come forward and take out the patent at once; or by the possible death of the inventor while waiting for a suitable season to arrive at which to obtain and develop his patent, the public would never receive the disclosure and so the valuable idea be lost forever to the world.

I can but think, then, that a renewal fee system would not only very seriously handicap these deserving citizens, but would in general tend to stifle and restrict the inventive activity of the country in a marked degree.

I do not think that the system would in any way tend to restrict or restrain wealthy corporations in the matter of so-called "blocking" or "protecting" patents, nor do I consider this matter as great an evil as it is by some considered. In almost all of these cases the disclosure to the public is fully worth the limited monopoly which it confers in exchange for same.

Would such fees tend to open up for development fields in fact, though not formally, abandoned by patentees? Probably not to any great extent, as, so far as I have observed, inventors never hesitate to apply for a patent on any improvement that may occur to them, regardless of the fact that the same is dominated by and can only be used in connection with some patented machine or device. And so, likewise, I do not believe the question of whether a dominating basic patent is alive or dead will have any effect in either promoting or retarding applications for improvements to be used in connection therewith. If the improvements are meritorious they will be used whether there are dominating patents in existence or not, and patents for them will be applied for, without regard to whether such basic patents are alive or dead.

Would the added cost of patent maintenance through such a system be sufficiently great to deter corporations, large or small, from disclosing their inventions through patents? Probably not, as the question of expense is one of the last matters considered by such corporations and the expense to them is always a small matter. As they all maintain a patent department in charge of a skilled patent attorney, the government fees and a small compensation to the inventive employee are the chief items of expense.

On the whole, then, I emphatically do not favor renewal fees, but if we are to have them then there should certainly be a reasonable time given to the inventor before the first fee is payable, to enable him to dispose of his invention or determine its utility. Seven years is none too long; a longer term would be better.

As to the size of the fee, it should probably be nominal; five dollars a year would be sufficient, the idea being merely to require the owner, by the payment of the fee, to definitely put himself on record as not yet being willing to dedicate his invention to the public. Any considerable increase in the size of the fee would be merely playing into the hands of the great corporations who would wait to freeze out the small inventor and force him to dedicate his invention to the public, so that they could then use it free, whereas if they had to wait out the 17 years for his rights to expire, if a corporation really needed the use of the invention they would be ready at once to agree to pay the inventor a reasonable compensation for the use of his invention.

In conclusion I desire to call the attention of this Division of the American Chemical Society to three bills now pending before Congress relating to the Patent Office and which are receiving the active support of and have been already approved by the Research Council, the various Patent Bar Associations and Chambers of Commerce of the United States, and of scientific and technical societies and organizations in general, and to earnestly request this Division to endorse these bills by some such resolution as that with which I will close this article.

These bills have in view the following objects:

First—An increase of salaries to a point commensurate with the high cost of living which apparently is as high if not higher in the city of Washington than elsewhere.

Second—The organization of a Court of Patent Appeals in order to relieve the various Circuit Courts of Appeal from the consideration of cases requiring special training in patent law and applied science and so doing away with the conflict of decisions in the various independent circuits, there now being no last court of resort to which appeal therefrom can be taken to settle the law.

Third—The separation of the Patent Office from the Department of the Interior and its organization as an independent department responsible to the President direct.

Salaries in the Patent Office particularly in the case of the corps of examiners are notoriously inadequate to attract and retain in office a force having the necessary legal and technical training. For many months the lower grade of assistant examiner has been to some little extent filled by temporary appointees who have not passed the Civil Service Examination required by law, the Civil Service Commission having been wholly unable to fill the existing vacancies in the corps of examiners from those passing the necessary examinations. Even before the declaration of war with Germany the Patent Office had become a mere training school for young men who after a few years' service would resign to accept better positions with patent attorneys and manufacturing corporations; and with the greatly increased cost of living, matters have reached the point where unless relief is given the condition of affairs will go rapidly from bad to worse.

The fact that the office revenues are ample should also be considered. The Patent Office, however, has never been allowed to expend its own revenues; all fees are covered into the Treasury of the United States and the office can expend only such moneys as Congress cares to appropriate for that purpose. Up to the present time the Patent Office has turned into the Treasury of the United States about eight millions of dollars over and above all moneys which it has expended.

As to the desirability of the establishment of a Court of Patent Appeals to take final jurisdiction of all patent cases it is wholly unnecessary to advance any arguments; the desirability of such a court is so manifest as to be self-evident.

As to the separation of the Patent Office from the Department of the Interior, the matter is simply the question of cutting a little government red tape. At the present time practically all appointments in the office are made under Civil Service rules, but solely on the nomination of the Commissioner of Patents approved by the Secretary of the Interior. The Secretary cannot himself appoint. The proposed change should simply leave all matters where they belong—in the hands of the Commissioner, the legal head of the department.

Will some one of the members present kindly offer a resolution in some such form as the following:

Resolved, By the Division of Industrial Chemists and Chemical Engineers, the Pharmaceutical Division, and the Dye Section of the American Chemical Society now in session at Philadelphia, Pennsylvania, that we heartily endorse the three bills now pending before Congress looking to

First—An advance in the compensations of Patent Office Employees covered by the bill H. R. No. 7010.

Second—The establishment of a Court of Patent Appeals, covered by the bill H. R. 5013.

Third—The separation of the Patent Office from the Department of the Interior and its organization as an independent department, covered by the bill H. R. 5011.

And we earnestly urge upon the Congress of the United States that the same be passed at the present session.

Resolved, That a copy of this resolution be transmitted to the Clerks of the House of Representatives and the U. S. Senate at Washington, D. C.

PATENT RENEWAL FEES

By W. R. Whitney, General Electric Co., Schenectady, N. Y.

The object of this paper is to express opinions on the principle of patent renewal fees, not because I know all the facts necessary for executive action, but because I want to contribute in order to learn more of them. My first thought on reading Dr. Hesse's letter of June 4 was that he had made a good case for renewal fees. As his facts receded from the foreground of my memory, I saw as the most appealing point of argument, the fact that the "dead German patent, therefore, still lives and rules in the United States," but on looking at it from different angles, I am not sure that even this is an evil to counterweigh added burdens to American inventors. There might be simpler ways to kill a living dead German patent, if that were desirable, than strangling American inventors. Judging, superficially I admit, from the enormous activity of American inventors, which has become a national characteristic, I am led to ask "Why change?" I do not know that added fees would have serious effect, but as Dr. Hesse points out, we ought to inform ourselves by contributing discussions.

I do not think added fees would greatly stifle or restrict inventive activity, because most inventors are persistent fellows, delayed, but not stifled, by such matters. I think that those who are not well backed financially would be handicapped, however. They would not so generally get their financial reward as at present. It may now come to them long after they have ceased to hope. To-day a man who is willing to consistently back himself, as an inventor, may prepare a wonderful future. This vision greatly stimulates experimental work. The way up hill is steep, and few are successful, but the thing is logical. He may make an invention, which, at the time, promises absolutely no commercial value, but which, owing to his foresight, will produce great returns. Finally he, or someone else, sufficiently develops the field which he foresaw and to which he contributed. I would not increase charges to him, nor reduce his chance of finally having his reward, where his foresight, as to public wants, has been so exceptional.

It may seem strange, but I do not know anything about "wealthy corporations maintaining blocking patents," and so the effect of added fees thereto seems uncertain. I believe that any additional fee would fail to deter them, if this fee were one which the average inventor could pay. There may be a blocking system in action where a manufacturer operates only one of his several patents on different products for the same service, or different processes for the same product. A would-be competitor is kept from using either, but the public has no interest in having second-rate things made, nor second-rate processes used, because finally it has to pay for them.

My impression is that the more complex the law and the more costly or complicated the patent processes, the greater will be the relative load on the individual inventor. Large companies employ experts whose business it is to be proficient in the law and efficient in its application. The individual inventor, on the other hand, is almost universally negligent in these matters, because he is properly and necessarily preoccupied by his inventive work. For that reason we ought to consider first the interests of the "authors and inventors" whom it is the object of our American patent law to encourage. Let us make their way smooth and their encouragement great, rather than sell them at, perhaps, almost prohibitive prices, and well above cost, something which even to themselves has only one chance in a hundred to win. It might be argued that the public need fees in order to pay for the clerical work connected with supplying a patent or renewing it from year to year, but no one has made this claim. I think it will be found that our Patent Office still makes a profit for the public out of the present method of encouraging inventions, and that there is nothing philanthropic in it. Is it not true, that even with what we think is liberality, the public, in order to encourage invention, practically sells the inventor at a first profit to itself, a piece of paper, a license to legal battle, which on the average is not worth its cost to the purchaser? Whenever it is valuable, we, the same public, take a second very much greater profit for all time in return for a small percentage allowed the inventor for a limited period. Might we not go farther in encouraging invention so that a man might even educate himself for it, instead of discouraging it to any increased extent, as proposed?

Any patented idea is more apt to be developed and made useful than the same idea without patent. The manufacturer only takes it up for the profit he expects to make. Frequently he must run a great risk in extensive development, and it is still to public interest that he do so. Therefore, there would be fewer inventions actually developed if the patents lapsed from failure to pay annual fees. An undeveloped invention, which all people are equally free to sell, if it requires expensive development, will find few who are willing to take the risk of development. A definite period of assured monopoly is often as necessary for the manufacturer as for the inventor. This necessary period may in cases be short and frequently constitutes, in practice, only the last few years of a patent's existence. Even the chance that the patent may prove to be valuable shortly before it expires, is a boon to the inventor which we might well leave to him. I think the kind of information we need before we form a fixed conclusion on this point, is, to what extent lack of a fee system in America has benefited or encouraged American inventors, and to what extent the foreign fee system has stimulated or advanced the arts and industries of those countries.

I do not know that I should object to encouraging the inventor type of young man even more, if possible, so that he would deliberately study science and engineering with the object of becoming a better inventor. Few aim to do this to-day, though men study to prepare themselves to be chemists, lawyers, poets, etc. This would seem to indicate that the present encouragement for inventors is insufficient and that most of them just happen, in spite of everything.

AN ARGUMENT AGAINST ANNUAL PATENT RENEWAL FEES IN THE U. S.

By A. D. LITTLE, Arthur D. Little, Inc., Cambridge, Mass.

Prior to the request that I express my opinion on it, I had given no thought to the subject of annual patent renewal fees in the United States, but in my past experience with foreign patents, I have always regarded such fees as an unmitigated nuisance, and I should expect them to prove equally burdensome here. This is not because the payments themselves are especially burdensome, but because of the necessity of keeping track of them from year to year and paying them in season. If the purpose of such fees is to throw open to the public, through lapses, patents which have been granted to an inventor who has fulfilled his part of the contract by making public disclosure of his invention, annual fees will undoubtedly tend to accomplish their object and they should obviously be made as large and as troublesome as possible. They would undoubtedly be some handicap to the poor inventor and might be expected to have a moderate inhibitive influence on inventive activity. I do not think they would tend at all to weaken the wealthy corporation, by whom the money value of fees would not be felt, and who could have the payments attended to by their legal departments.

There is something to be said in favor of the fees as regards their tending to open up for development fields which have in reality been abandoned by patentees. They would tend to clear away dead wood. Upon the whole, however, I am opposed to annual fees and the fundamental basis of my objection is this—the inventor is under no obligation to disclose his invention to the public. It is, however, to the advantage of the public that such disclosure be made. A patent is a contract between the Government and the inventor, by which the Government in order to induce the inventor to make the desired disclosure, and in consideration thereof, grants him a monopoly for seventeen years. Obviously, the inventor delivers the goods when he makes the disclosure, and in the nature of things, he cannot recall them. The Government, having induced him to make the disclosure, should not, in fairness, cut short his monopoly or make it contingent upon a succession of burdensome fees and regulations.

PATENTS AND ANNUAL RENEWAL FEES

By J. M. FRANCIS, Parke, Davis & Company, Detroit, Michigan

It happens that the writer has, for the past year or two, served as chairman of a special committee of the American Drug Manufacturers' Association on Patents and Copyrights.

I have given a great deal of study to the various published articles upon this subject and have corresponded with officers of similar organizations who have the same interest in view.

At first glance, one is inclined to indulge in rather precipitate conclusions and hence freely to point out the shortcomings of

American patent law and procedure, and then to offer a panacea.

After devoting several months to a close study of the question, however, one begins to get some small idea of its ramifications and furthermore, to appreciate its tremendous influence upon the development of industrial life in America. By this time comes a realization of the tremendous stake involved and that our laws are so broad and so just that we cannot but feel that its few disadvantages or imperfections are greatly outweighed by their benefits and excellencies.

The main difficulty in my mind lies in the fact that there are so many diverse interests involved in the consideration and enforcement of the patent laws of this country, that when Congress once begins to attempt to modify some of these manifestly imperfect sections, it will let loose the floodgates with the possibility that narrow and even fanatical opinion may rule, and that some of the manifest advantages of our patent system may be lost in the attempt to correct some of its minor features which appear disadvantageous.

This all leads up to a recommendation on my part that while discussion should be indulged to an unlimited degree, any action or resolution on the part of the SOCIETY should be controlled with the utmost care; and by all means let us refrain from doing anything hastily.

I can see the disadvantages pointed out by Dr. Hesse in his article published in *The Journal of Industrial and Engineering Chemistry* of July 1919 and I am frank to say that I can conscientiously support his proposition insofar as the principle is involved.

As the matter appears to me, however, I really fear that Dr. Hesse's remedy will wholly fail to accomplish the desired result.

The gist of his contention is that inventors allow patents to lie idle, thus transgressing the spirit underlying the patent system, and that this may be partially remedied by the payment of an annual tax.

He states furthermore that the annual tax shall consist of a modest sum of perhaps $25; in other words, one which will cause the surrender of a large number of such patents and yet not large enough to be a burden to the comparatively poor inventor.

I cannot for an instant believe that a patent which promises to be of any very considerable value *per se* or which may be indirectly valuable in blocking the efforts of others, could be released by requiring the annual payment of any such sum as $25 or even $100.

The majority of such patents as are held in quiescent condition and which are calculated materially to interfere with industry are not those that are taken out, *or at least permanently held*, by men of small means, but are generally taken out by or quickly fall into the hands of institutions of great wealth, who would no more hesitate at the paying of an annual fee of $100 or $200 than they would at paying a fee of $10 or $25.

Inversely, demanding a fee sufficiently high properly to penalize the great institutions who are most likely to indulge in such practice would, on the other hand, prove a most serious burden to the inventor of small means.

Frankly, I believe that very little is to be accomplished by the proposed measure. Nevertheless, I am prepared to support it in principle, at least, leaving the details as to the sums to be collected annually to be determined after proper discussion.

In carrying out a scheme of this kind, however, I would certainly most positively favor allowing patent control without any fees whatsoever (more than those necessary for registration) for a term of five years.

TAXING UNITED STATES PATENTS

By T. HART ANDERSON, Patent Lawyer, New York City

Concerning the question of taxing United States patents, I do not advocate such a proceeding as a matter of general application to all patents. In all my experience of thirty years' practice of the law, particularly devoted to patent law, I do not know of a single instance where a patent has been used solely for the purpose of "blocking" the inventor of an alleged improvement. My experience has been that patents are relied on by the owners thereof to protect a business built up and founded thereon and not otherwise. I am in favor, however, of taxing all United States patents granted to citizens of those foreign countries in which a tax is imposed upon patents granted in their own countries to United States citizens and to the same extent, as a means of preventing citizens of foreign countries from preserving in the United States patents for inventions for which patents granted in their own countries have been allowed to lapse. I would restore that provision of our laws which provided that United States patents granted for the same invention covered by lapsed patents in a foreign country should lapse in this country also. This, it seems to me, would have the effect of opening up competition with foreign owners of United States patents whose patents have been allowed to lapse in their own country. In my judgment a tax, no matter how high it might be, would be paid by any one who had a valuable and comprehensive patent. As for the thousands of useless patents—the imposition of such a tax might cause the owner to allow them to lapse, but as to such patents it is immaterial to any one whether they lapse or not.

RENEWAL FEES ON PATENTS

By T. B. WAGNER, Vice-President U. S. Food Products Corporation, New York City

I am deeply interested in anything pertaining to our patent system, and while heretofore I have not been able to form a conclusive opinion on the subject of renewal fees, a reading of Dr. Hesse's article published in the July issue of *The Journal of Industrial and Engineering Chemistry*, inclines me strongly towards the affirmative. I find myself usually in accord with Dr. Hesse's utterances and the present is no exception. I believe that the suggested progressive fee, totaling $550 at the end of the seventeenth year, ought not to work any hardship upon the inventor with limited means, but it ought to prove a distinct burden upon those foreign corporations who take an altogether too liberal advantage of our feeless system.

PATENTS—AMERICAN AND FOREIGN

By JOHN URI LLOYD, Lloyd Brothers, Cincinnati, Ohio

My experience with patents both American and foreign leads me to state that I prefer the American process, wherein one payment covers the patent from the beginning to its end.

DR. HESSE'S SUGGESTION OF RENEWAL FEES

By L. H. BAEKELAND, Patent Office Committee, National Research Council

Although there are some good arguments in favor of the suggested reform of Dr. Hesse, the matter will specially prove detrimental to individual inventors of limited means. A wealthy company or a rich inventor can well afford to keep patents alive, by paying a small annual renewal fee.

There is no reason, however, why the subject should not be freely discussed. But I am under the impression that this suggested reform, as well as many other small reforms, will only distract attention, at this time, from the much more important fundamental reforms, such as the reorganization of the Patent Office and the reorganization of our system of court procedure through the creation of one single Court of Patent Appeals.

ORIGINAL PAPERS

MODIFICATIONS OF PEARCE'S METHOD FOR ARSENIC

By JOHN WADDELL

Received March 27, 1919

Owing to the difficulty my students experienced in using the Pearce method for determining arsenic in a cobalt ore, I decided to carry out some experiments.

Pearce's original method consisted in fusing the ore with sodium carbonate and potassium nitrate, extracting the fused mass with water, boiling the filtrate with excess of nitric acid to drive off carbon dioxide, neutralizing with ammonia, precipitating the arsenate as silver arsenate, dissolving this precipitate in nitric acid, and titrating the silver with potassium or ammonium thiocyanate. Since silver arsenate is soluble not only in nitric acid and in ammonia, but also to a slight extent in ammonium nitrate, the results are not quite satisfactory.

Canby[1] recommends neutralization of the nitric acid with zinc oxide in excess. He directs that should the zinc oxide cause precipitation of silica or alumina (Canby fused in a porcelain crucible) to filter off, and to the filtrate add more zinc oxide.

Bennett[2] criticizes Canby's method, stating that it is practically impossible to get the zinc oxide to neutralize the nitric acid and that, therefore, silver arsenate is not completely precipitated. He himself recommends that after fusion and filtration from the residue obtained by leaching in hot water the filtrate shall be acidified with acetic acid and boiled. After cooling, phenolphthalein is added as indicator and caustic soda solution to slight alkalinity and then just enough very dilute acetic acid, drop by drop, until the color is discharged. Silver nitrate is then added and the arsenate titrated as usual.

It may be noted that Bennett read his burette only to the first place of decimals and that the quantity of potassium thiocyanate was small, ranging for the same quantity of arsenic between 8.3 cc. and 8.7 cc., the greater number of the determinations being 8.6 cc. This last number he probably considered nearest correct, for he took for each determination what was supposed to be 0.025 g. of *impure* arsenic trisulfide, and 8.6 cc. gave 0.024725 g. of arsenic trisulfide, and 8.7 cc. gave 0.025013 g. It is to be noticed that Bennett, while he reads the burette to the first place of decimals only, calculates the weight to the fifth significant figure. Since silver acetate is only sparingly soluble, especially in a solution containing, as Bennett's did, considerable sodium acetate, I think it probable that not only 8.7 cc. but also 8.6 cc. was too high and that the 8.3 cc. may have been nearer right. Bennett gives no method for checking his results.

A number of my students got entirely discordant results in using the two methods, and in fact got discordant results in determinations by the same method. In some cases, if not in most, in the Canby method, the zinc oxide had been filtered off before precipitating with silver nitrate and as zinc nitrate gives a precipitate with sodium arsenate it was natural to conclude that arsenic had been lost in this way. Concordant results, however, were not obtained even when the zinc oxide was not filtered off and it seemed likely that the zinc arsenate was not all changed into silver arsenate. Even if the silver nitrate was added first and the zinc oxide afterwards, the results were still unsatisfactory. It seemed evident then that the zinc nitrate reacted on silver arsenate and gave an error, and it was found by a qualitative test that silver arsenate when digested with a concentrated solution of zinc nitrate became lighter in color, white zinc arsenate doubtless replacing silver arsenate.

It seemed then reasonable to conclude that when in the Canby method any considerable excess of nitric acid was present, the zinc nitrate produced prevented the precipitation of all the arsenic as silver arsenate, and that if the excess of nitric acid was very small the results might be accurate.

Accordingly, a solution of sodium arsenate, $Na_2HAsO_4.12H_2O$, of approximately 4 g. per l. was tested. Four lots of 100 cc. each were boiled in Erlenmeyer flasks with 5 cc. of concentrated nitric acid. In Flask A, zinc oxide was added and allowed to stand for about an hour before addition of silver nitrate solution. The precipitate of silver arsenate did not come down at once, but after a few minutes a considerable amount was precipitated. In Flask B, the silver nitrate solution was added first and afterwards zinc oxide. No precipitate appeared for an hour or two. In Flask C, the nitric acid, after cooling, was neutralized and the solution made slightly alkaline, using phenolphthalein as indicator, by dissolving pure caustic soda directly from the stick, so that carbon dioxide would not be taken up from the air. Then the color of the phenolphthalein was discharged by adding very dilute nitric acid drop by drop; excess of silver nitrate was added and a small quantity of zinc oxide. In Flask D, the solution was made alkaline as before and dilute acetic acid was added until there was a drop or two in excess, after which the precipitation was made with silver nitrate.

It may be mentioned that the silver arsenate precipitate in A and B was dark brown; and often, though not always, the precipitate from the nitrate solution was slightly darker than that from the acetate solution. This did not seem to be due either to the contrast of color with the white zinc oxide on the one hand, or to the presence of white silver acetate with silver arsenate on the other. So far as I could detect, the composition did not vary with slight differences of shade.

The four flasks were allowed to stand for a fortnight, being occasionally shaken so that the zinc oxide should have every opportunity to react on the nitric acid. The filtration was done in Gooch crucibles with asbestos, and the crucibles after filtration were placed

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[1] *Z. anal. Chem.*, **29**, 187, abstracted in *J. Chem. Soc.*, **58** (1890), 923.

[2] *J. Am. Chem. Soc.*, **21** (1899), 431.

in beakers; the Erlenmeyer flasks were washed out with about 20 cc. hot nitric acid (1 : 1) which was then brought into the crucibles in the beakers. The silver arsenate dissolved easily, the solution was made up to about 200 cc., the crucible was removed, the asbestos being left in the beaker, and after addition of 5 cc. saturated solution of ferric alum, the silver was titrated with ammonium thiocyanate. The results were as follows:

AMMONIUM THIOCYANATE REQUIRED

	Cc.
A	18.90
B	20.40
C	39.10 39.25
D	38.69

It was thus seen that with zinc oxide used to neutralize a large amount of nitric acid the results were valueless. This was not, however, as Bennett suggests, because zinc oxide does not neutralize the acid, for the filtrate from the mixture of zinc oxide and silver arsenate was neutral to methyl orange, though a drop or two of very dilute nitric acid gave the red color.

To test the method, I dissolved 1.5 g. of Kahlbaum's pure arsenious anhydride in nitric acid made up to 500 cc. and took lots of 25 cc. each. After I had done some titrating myself I asked one of my students, Miss Lucille Corbett, to do some determinations, which she carried out both on my solution and on one which she prepared for herself. In my determination by the Bennett method I added sodium acetate in considerable excess to use up the nitric acid, while Miss Corbett added caustic soda to slight alkalinity and then acetic acid until slightly acid. Her figure thus obtained was less than mine and more nearly those of the Canby method which in this and subsequent tests was carried out in the modified style with only a slight excess of nitric acid to be neutralized by zinc oxide.

Miss Corbett and I used the same solution of thiocyanate and the same burette and took, respectively, 27.10 cc. and 27.20 cc. thiocyanate for 0.5 g. of silver nitrate. We used the second figure which gave 1 cc. thiocynate = 0.002704 g. arsenic (Ag = 108; As = 75). One of Miss Corbett's determinations in each case was made with my solution and the other with her own. Another student, P. A. Poynton, using a different burette and a different thiocyanate solution which was, however, of almost exactly the same concentration as mine, made this determination also.

	Canby Method Cc.	Bennett Method Cc.
Waddell	20.98 21.00 21.05	21.40
Corbett	20.85 20.86	20.93 20.90
Poynton	20.81	21.08

With my solution of thiocyanate, 21.00 cc. corresponded to 75.68 per cent of arsenic, while with Poynton's 21.08 cc. gave the same percentage, the calculated value being 75.75.

The next experiments were made with arsenious anhydride fused with ten or twelve times the amount of sodium peroxide. In all the fusions which follow sodium peroxide was used instead of a mixture of sodium carbonate and potassium nitrate, a nickel or iron crucible being employed.

The fusion, after extraction with water, was made up to a liter or half a liter as the case might be, and a sufficient quantity taken to require at least 14 cc. of the thiocyanate. Miss Corbett evidently lost some arsenic by volatilization but the results by the two methods agreed closely. The freeing of the residue from arsenic, by extraction of the fused mass with water, is difficult. In my experience, it was not possible to wash out all the arsenic when filtering through asbestos in a Gooch crucible. I filtered by preference through a large filter paper and washed till the washings were no longer alkaline. The residue should always be dissolved in hydrochloric acid and tested with a current of sulfureted hydrogen. It is needless to say that delicate tests such as the Gutzeit in even its crudest form would be certain to show arsenic in the residue, and are not worth trying.

	Canby Method Per cent As	Bennett Method Per cent As
Waddell	74.54 75.21	75.96 76.49
Corbett	70.91	71.06
Poynton	76.15	78.46

The average of my lowest Bennett and highest Canby is 75.64 per cent As, the calculated being 75.75 per cent. It may be noted that in taking only 15 cc. of thiocyanate a difference of unity in the second place of decimals in reading the burette makes a difference of five in the second place of decimals in the percentage. It will thus be evident what degree of accuracy Bennett attained when his determination required only 8.6 cc. and was read merely to the first place of decimals.

Analyses were made of mispickel. Miss Corbett, Poynton, and I each fused separate lots of 0.2 g. and determined the arsenic in the whole amount. Afterwards the other two fused 0.5 g. of mispickel, made up to a definite volume, and took sufficient of the solution for the determination. The second line for each in the table gives these results.

	Canby Method Per cent As	Bennett Method Per cent As
Waddell	22.91	23.38
Corbett	23.00 23.38	23.79
Poynton	24.04 23.68	24.23 23.61

It will be noted that one of Miss Corbett's results by the Canby method was the same as mine by the Bennett method.

Three other students also made analyses of mispickel taken from the same bottle as before but at a different time, their sample being sifted through an 80-mesh sieve. They all used the same burette and the same thiocyanate solution, both burette and solution being different from those already mentioned. H. K. Rowley had already in another laboratory done a number of analyses using Bennett's original method in which there was a large excess of sodium acetate, assuming that his results there obtained were correct. He was asked to compare his former procedure with the proposed modification; and the results given below indicate that the suspicion that Bennett's results were too high was correct. R. J. Young and J. S. Stauffer used only the modified method.

	Canby Method Per cent As	Bennett Method Per cent As
Rowley	24.92	25.48 24.82
Stauffer	24.39	24.90
Young	24.55	25.02

With the single exception mentioned, none of the students had attempted the analysis before and in the case of all it was part of their prescribed course. None of them was able to spend enough time to carry out a complete research; but to all, the difficulties were explained and the object to be attained was pointed out and they carried out their analyses with the aim and in the spirit of research.

Two other students, H. C. Boehmer and I. L. Sills, did some pioneer work over a year ago, chiefly in varying tests of Canby's method, and though their results are not included in this paper, their work was as important as that of the others. I may add that in work like this, I think it is possible for students in the second year of their analytical course to get some insight into the methods of research which will help them towards the initiative and judgment so much desired by the industries employing university students and graduates.

SUMMARY

I—Bennett's modification of Pearce's method for arsenic, if carried out as he describes, is likely to give too high results, unless arsenic has been lost by volatilization or otherwise, while Canby's modification, if carried out as he describes, may be so low as to be valueless.

II—Both methods may be modified to give practically concordant results; and if duplicates, determined one by the Bennett method and the other by the Canby method, each modified as described, agree, then the result may be considered correct.

III—In the modification of Bennett's method, any large amount of alkali is acidified with nitric acid, made slightly alkaline with pure caustic soda and very slightly acid with acetic acid, before precipitation of the arsenate as silver arsenate. In the modification of the Canby method the process is similar, except that instead of acetic acid, nitric acid is added in very slight excess and, after addition of silver nitrate, this small excess is neutralized by zinc oxide.

IV—Various determinations are given illustrating the degree of accuracy.

Chemistry Department
Queen's University
Kingston, Ontario

AN IMPROVED METHOD FOR DETERMINATION OF CARBON BY WET COMBUSTION, USING BARIUM HYDROXIDE AS ABSORBENT

By P. L. Hibbard

Received March 10, 1919

For the determination of carbon by wet combustion, the writer has for more than a year used a modification and combination of previously published methods[1,2,3,4,5] with much success. The method is simple, convenient, inexpensive, rapid, and accurate. It is here presented, with the hope that it may be of use to others.

Complete combustion is secured by suitable proportion and quantity of reagents. Carrying over of volatile acid fumes to the absorbent is avoided by an efficient purifying train. Convenience and accuracy in use of barium hydroxide as absorbent for carbon dioxide are secured by a simple and efficient apparatus without difficult manipulation.

The operation is briefly as follows: The substance is heated in a Kjeldahl flask with chromic anhydride and sulfuric acid whereby carbon is oxidized to carbon dioxide which is carried into a solution of barium hydroxide by a current of purified air. After the reaction is completed the excess of barium hydroxide is determined by titration with standard hydrochloric acid. The amount of barium hydroxide neutralized by carbon dioxide measures the amount of carbon in the substance taken.

DESCRIPTION OF APPARATUS

By reference to Fig. I the various parts and arrangement of the apparatus may readily be discovered. First is a bubble tube A, containing a few drops of colored liquid as indicator of the speed of the air current. B is a large test tube filled with soda lime for purifying the incoming air. C is the regulating stopcock; D is a funnel tube with a long stem extending down to the bulb of the Kjeldahl flask F. The end of this long stem is somewhat drawn out to a small opening. Upon D, connected by a two-hole rubber stopper rests E, a graduated dropping funnel for measuring the reagents. F is a long neck, 300 cc. Kjeldahl flask, used for the combustion chamber. From this the gas passes through a glass tube to the bottom of G, a large test tube drawn out at the lower end and fitted with a pinchcock and rubber tube. This acts as the condenser to remove most of the water from the gas. After each combustion is finished the water is drained out of this tube by opening the pinchcock. From G the gas passes through a long tube down to H, a 50 cc., wide-mouth flask containing about 10 cc. of strong sulfuric acid. Upon H, which is fitted with a two-hole rubber stopper, rests a glass tube, I, filled with glass beads wet with sulfuric acid, the purpose of which is to dry the gas. Upon I, connected by a rubber stopper, rests J, a similar tube filled with granulated amalgamated zinc, the function of which is to remove sulfuric acid or other acid fumes from the gas. From the purifying tube J the gas passes through a long tube down to the 500 cc. Florence flask K, which is connected by a two-hole rubber stopper to the Meyer bulb tube L. The lower end of this bulb tube is bent so as to almost touch the bottom of the flask. At the upper end the bend next to the large bulb is partly straightened out so that the bulb stands upright.

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[1] Ames and Gaither, This Journal, **8** (1916), 1126.

[2] Truog, *Ibid.*, **7** (1915), 1045.

[3] Schollenberger, *Ibid.*, **4** (1912), 436.

[4] Gortner, *Soil Science*, **2** (1916), 395.

[5] Brady, This Journal, **6** (1914), 843.

This Meyer bulb tube stands at an angle of about 30° with the horizontal. Above the large bulb of the Meyer tube, connected by a rubber stopper, is a small bulb, M, used as a safety trap to prevent carrying over any of the liquid. This bulb M is connected with the suction by N. The suction apparatus may be any form of aspirator or vacuum pump which gives a vacuum equal to about 2 in. of mercury. I use a pressure regulator consisting of a narrow cylinder containing mercury and fitted with a three-hole rubber stopper. One hole is for the connection to the Meyer bulb, one is for the connection to the suction, the other carries a straight glass tube extending about 2 in. below the surface of the mercury. This regulates the vacuum so that if there is more than enough to raise a column of 2 in. of mercury it is relieved by air passing in through this open tube.

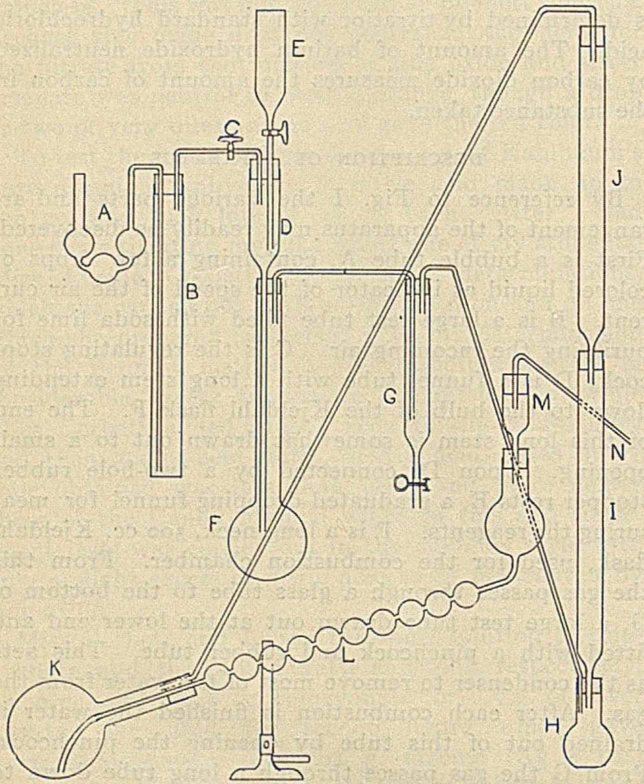

FIG. 1

The whole of the purifying apparatus and the combustion flask are carried on a single, ordinary ring stand. The absorption flask, which may be either a Florence flask or an Erlenmeyer, in an inclined position rests on the table and supports one end of the Meyer bulb tube, the other end of which is supported by a small ring stand.

The above described combustion apparatus comprises a single unit. If it is desired to use more than one the primary purifying train and suction apparatus may be used in common for all of them and it will be easily possible for one person to handle half a dozen units like this at once.

It has been found that this absorption apparatus is more easily handled, more easily washed out, and works better than Truog's ingenious bead tower.[1]

The difficulties which previous experimenters have found in preventing the passage of acid fumes from the digestion flask into the absorbent liquid is perfectly overcome by means of the bead tower with sulfuric acid followed by the tube of granulated zinc. It was found that it was necessary to keep the zinc dry in order to secure efficient working.

THE CONTAINER FOR BARIUM HYDRATE

This consists of a large bottle fitted with a good sized soda-lime tube for purifying all the air that enters the apparatus. The barium hydroxide is drawn off and measured by means of a 50 cc. automatic overflow pipette. The upper end of this pipette is connected back into the top of the bottle so that only air which has passed through the soda lime can enter it. By this means the barium hydroxide may be readily measured out in exact amount and preserved indefinitely from contamination by the air.

DESCRIPTION OF THE METHOD

In the combustion flask place the substance which may contain from 0.10 to 0.15 g. of carbon, for example 0.3 g. of sugar, or 10 g. of soil; connect up with the purifying apparatus. In the 500 cc. Florence flask place 100 cc. of *N*/3 barium hydroxide and 50 to 60 cc. of carbon dioxide-free water. The amount of water added should be such that the barium hydroxide will rise only into the lower part of the large, upper bulb of the Meyer tube when the suction is in operation. This may also be partly regulated by raising or lowering the absorption flask K on the lower end of the Meyer tube. Connect up and turn on the suction so that carbon dioxide-free air passes at the rate of 150 to 200 cc. per min. Place 15 cc. of chromic acid solution in the dropping funnel E over the combustion flask and run it into the combustion flask. If the substance to be burned is readily decomposed the chromic acid must be added slowly in order to avoid a too violent reaction with consequent back pressure, causing low results. Now add 45 to 50 cc. strong sulfuric acid to the dropping funnel and run it cautiously into the combustion flask to avoid too violent reaction. During this time the current of air should pass regularly with no back pressure. After the reagents are added heat gently with a small flame until the acid boils. Continue boiling about 15 min. or until the mixture bumps. The whole time should be 25 or 30 min. The reaction is probably complete as soon as the acid boils, but the rest of the time is allowed to sweep all of the carbon dioxide into the absorption vessel. When completed, remove the heat, shut off the suction, disconnect the absorption tube and flask, and rinse out the barium hydroxide from the Meyer tube into the absorption flask with carbon dioxide-free water, using about 200 cc. Stopper the flask and set it aside. The apparatus is now ready to start another combustion, as at first, by substituting a new evolution flask and a freshly charged absorption flask. When this has been properly started it requires no attention for about 20 min. At any convenient time the final titration may be made, or one may wait until ready to make a number of them at once.[1] Add to the liquid in the absorption flask

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[1] *Loc. cit.*

[1] *Loc. cit.*

4 drops of phenolphthalein solution, 0.2 per cent, and run in standard $N/3$ hydrochloric acid until the pink color disappears. There is no means of knowing when the titration is nearly completed so that it is necessary to proceed cautiously in order to avoid adding too much acid. If this should happen it may be remedied by immediately adding one or two cc. of the standard barium hydroxide, then continuing with the acid carefully to the end-point. A blank should be run for the same length of time and with all the reagents and the same amount of barium hydroxide. The amount of hydrochloric acid required for the determination subtracted from the amount required for the blank gives the amount equal to the carbon dioxide formed: 1 cc. $N/3$ acid = 2 mg. of carbon.

APPLICABILITY OF THE METHOD

As the temperature in the reaction flask is that of boiling sulfuric acid it is obvious that the method is not suited for the combustion of volatile substances. It does serve well for the determination of carbon in soils, manures, and agricultural products in general, such as grains, fodders, etc.

PREPARATION OF REAGENTS

BARIUM HYDROXIDE—This is approximately $N/3$. If the solution is much stronger than this it is apt to crystallize out when it gets cold.

STANDARD HYDROCHLORIC ACID—This is $N/3$, standardized by any convenient method. 1 cc. is equivalent to 2 mg. of carbon.

CHROMIC ACID—170 g. of chromic anhydride (CrO_3) is dissolved in 300 cc. of water. Add 25 cc. of sulfuric acid and boil gently for 15 min. to remove any carbon that might be present. Cool and make up to 500 cc.

SULFURIC ACID—Ordinary C. P. concentrated acid, free from carbon.

CARBON DIOXIDE-FREE WATER—This is easily made in quantity by bubbling air which has been freed of carbon dioxide by passing over soda lime or caustic potash, through the distilled water for an hour or two. To determine its freedom from carbon dioxide add a drop or two of phenolphthalein to 100 cc. of the water, then add a drop of barium hydroxide and mix. The water should be strongly colored.

ACCURACY OF RESULTS

The accuracy of the results obtained may be tested by the combustion of substances of known composition. The following results were obtained:

	PER CENT CARBON		
	Theory	Found	
Urea	20.0	20.08	19.84
Sugar, 99.6 per cent pure	41.9	41.6	41.5
Soil	..	1.374	1.370
$CaCO_3$	12.0	11.86	11.86

The strength of barium hydroxide used is such that 1 cc. equals about 2 mg. of carbon. As it is possible to duplicate results within 0.1 cc. this indicates that the error would be 0.2 mg. of carbon. By using an absorption apparatus similar to the Truog tower and with barium hydroxide of one-tenth the above strength and with some extra precautions, it has been found possible to determine accurately carbonate carbon in soils with an error of only one or two p. p. m.

COMPARISON WITH THE GRAVIMETRIC METHOD USING SODA LIME FOR ABSORPTION

The above described apparatus is somewhat simpler and more easily obtainable than that required for the gravimetric method and there is no difficulty due to moisture which must be guarded against in the gravimetric determination. It seems probable that a larger number of units of the volumetric apparatus could be operated by one person than of the gravimetric apparatus. Furthermore it is probable that the error of determination is less in using the volumetric apparatus. This is because the soda-lime absorption bulb is very heavy so that small changes in weight are not readily detected except by means of an extra good balance. On the other hand, in case but few determinations are to be made it will be simpler to use the gravimetric method, as in this case there are fewer solutions to be prepared, and fewer reagents are required. Consequently a few results would be more quickly obtained by this method. As to errors of manipulation it is largely a question of personal error as to which method will prove more satisfactory.

AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA

THE DETERMINATION OF METHYL CHLORIDE IN GAS MIXTURES[1]

By V. C. ALLISON AND M. H. MEIGHAN

Received March 28, 1919

In the chlorination of natural gas, some method of quickly and approximately determining the methyl chloride produced was necessary as a control over the operation.

In looking over the literature the only method which the authors found described for analyzing methyl chloride was that of heating over soda lime.[2]

As it was desired to analyze a great number of samples a day, the soda-lime method was far from satisfactory from the standpoint of rapidity.

Considerable time was expended in investigating and developing various suggested methods of determining methyl chloride and part of our results appear in this paper.

PHYSICAL PROPERTIES OF METHYL CHLORIDE[3]

The gas is colorless and burns with a bright flame, edged with green
Vapor Density = 1.73 (calculated = 1.75)
Specific Gravity = 0.9915 at —23.5° C., and 0.9523 at 0° C.
Specific Volume = 50.8
Solubilities: 1 volume of water dissolves 5.03 volumes of methyl chloride at 7° C. and 3.46 volumes at 20° C.
1 volume of alcohol dissolves 35 volumes of methyl chloride
1 volume of glacial acetic acid dissolves 40 volumes of methyl chloride (the authors found a somewhat greater solubility in glacial acetic acid)

Vapor Pressure[4] Atmospheres	Temperature Deg. C.
2.48	0
4.11	15
6.50	30

CHEMICAL REACTIONS[5]

When passed through a red-hot tube it deposits carbon and yields hydrochloric acid, methane, ethylene, carbon monoxide, and naphthalene.

MATERIAL USED

In our chlorination apparatus the chloroform and carbon tetrachloride were removed by water scrubbers,

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[1] Published by permission of the Director of the Bureau of Mines.

[2] Watts' "Dictionary of Chemistry."

[3] *Ibid.*

[4] Thorpe's "Dictionary of Applied Chemistry."

[5] A. Perrot, *Technical Paper* 101, 375.

the dichlormethane and most of the water vapor by an ice-salt bath, and the excess chlorine by a soda-lime tower. It is assumed that no carbon monoxide or hydrogen are formed in the reaction. The effluent gas then consisted of methyl chloride, natural gas, and water vapor.

The authors also secured some commercial methyl chloride from the Frigidor Corporation of New York. It was desired to establish the purity of this commercial product so as to use it in developing a rapid method of analysis suitable as a control in our chlorination work.

This methyl chloride was analyzed by fractionation at low temperatures and low pressures in the low temperature gas fractionation apparatus,[1] modified according to the diagram given in Fig. 1.

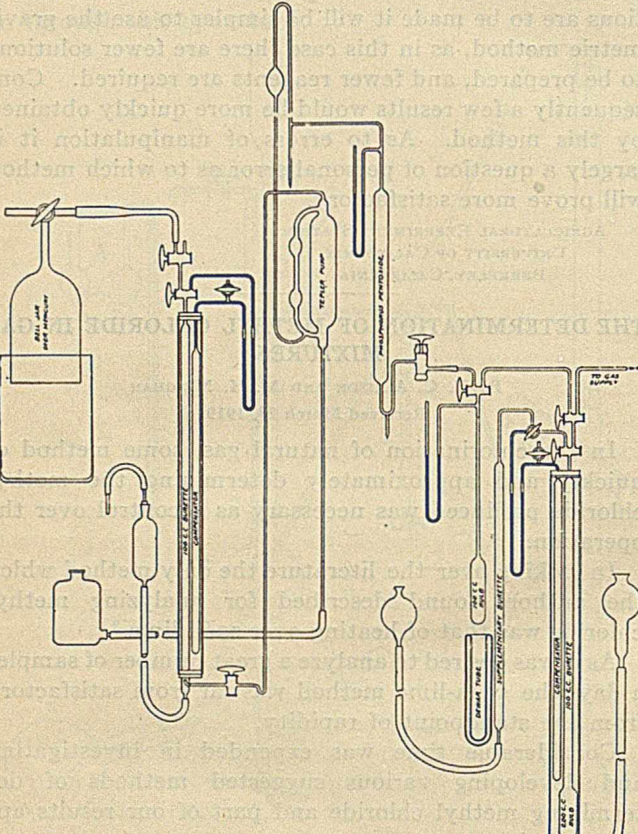

Fig. 1—Apparatus for Analysis of Gases by Fractionation

The procedure is essentially as follows:

Before the analysis the whole system is evacuated up to the stopcock of the measuring burette. The gas to be analyzed is run into a burette and measured. It is then condensed into a small bulb which is immersed in a liquid air bath. If the gas in the bulb contains any constituent which possesses a measurable vapor pressure at this temperature, it is pumped off by means of the Toepler pump into another burette and measured. It is then removed and subjected to a combustion or other suitable analysis.

The temperature of the bulb is now raised until some other constituent of the condensed gas possesses a measurable vapor pressure. This gas is then handled as before. The bath used above the temperature of liquid air is a pentane bath cooled to the desired temperature by means of liquid air. The temperature of this bath will rise about 5° C. while a given gas is being pumped off.

The vapor pressure of the methyl chloride from the Frigidor Corporation was as follows:

Temperature Deg. C.	Vapor Pressure Mm. of Hg
—103	3
—95	5.5
—81	12

At about —75° C. the vapor pressure rapidly dropped and was practically negligible at —70° C. (We started pumping off at —103° C. and stopped pumping at —70° C.) This fraction which came over between —103° C. and —70° C. was assumed to be all methyl chloride. Two samples thus gave 98.8 per cent and 100 per cent, or an average of 99.4 per cent methyl chloride. There was no water vapor present in the sample.

DETERMINATION BY THE GLACIAL ACETIC ACID METHOD

The high solubility of methyl chloride in glacial acetic acid immediately suggested its use in its determination.

In this method the gaseous methyl chloride or methyl chloride mixture is measured in a gas burette and passed six times into a Hempel pipette containing glacial acetic acid. The remaining gas is brought back into the burette and measured. The contraction indicates the methyl chloride present in the sample. The number of passes is limited to six on account of the solubility of natural gas in the acid (4 volumes of natural gas are soluble in 1 volume of glacial acetic acid) and we wished primarily to analyze samples containing natural gas.

The absorption of methyl chloride by glacial acetic acid is apparently a physical phenomenon as indicated by the following:

(*a*) The residual partial pressure of methyl chloride, in a series of gas mixtures varying in methyl chloride content from 10 per cent to 90 per cent, was approximately a constant after absorption in the glacial acetic acid.

(The solubility of methyl chloride in glacial acetic acid is so great that the increasing vapor pressure in the gas phase, due to the increasing methyl chloride concentration in the liquid phase, can be disregarded over an interval of several analyses.)

(*b*) After saturating glacial acetic acid with methyl chloride it was neutralized and titrated with silver nitrate for hydrochloric acid and less than 1 per cent of the hydrochloric acid equivalent to the methyl chloride present was found, indicating that the reaction $CH_3Cl + CH_3COOH = HCl + CH_3COOCH_3$ did not take place.

(*c*) A sample of the acid that had been used for several days (not nearly saturated, however) was neutralized with carbonate-free sodium hydroxide

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[1] G. A. Burrell, F. M. Seibert and I. W. Robertson, "Analysis of Natural Gas and Illuminating Gas by Fractional Distillation at Low Temperatures and Pressures," Bureau of Mines, *Technical Paper* **104** (1915).

and each cubic centimeter of the acid gave up 5.3 cc. of methyl chloride.

Water vapor and air decrease the methyl chloride value obtained by the glacial acetic acid, while natural gas increases this value due to the solubility of the natural gas in the acid. As the acid becomes saturated with methyl chloride its powers of absorbing it are correspondingly reduced and low values result.

The natural gas used in these mixtures was supplied from the mains at Pittsburgh, Pa., and has the approximate analysis of 86.3 per cent methane, 9.9 per cent ethane, 2.7 per cent propane, and 1.1 per cent nitrogen.

The curves obtained by plotting the methyl chloride content of known mixtures against that given by the glacial acetic acid on the same sample are given in Fig. 2.

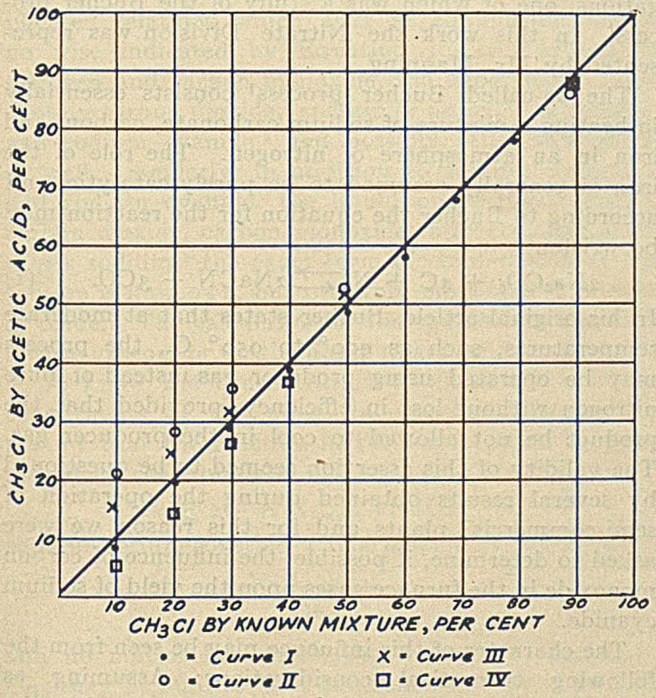

Fig. 2

Curve I, Fig. 2, is a methyl chloride-air mixture with no water vapor present except that contained in the air used and varying from 10 per cent to 90 per cent methyl chloride. The straight line indicates where the points would fall if the acetic acid gave the true value of the methyl chloride in the mixture. The distance of the points from the line probably lie within the limits of experimental error although air slightly decreases the absorption of methyl chloride by glacial acetic acid.

Curve II, Fig. 2, is a methyl chloride-natural gas mixture with no water vapor present except that present in the gas. The methyl chloride content of the various mixtures ranges from 10 per cent to 90 per cent. In the mixtures of low methyl chloride content the solubility of the natural gas in the acetic acid, although only one-tenth that of the methyl chloride, becomes of great importance because of the large partial pressure of the natural gas in the mixture in comparison with the low partial pressure of the methyl chloride. Above 40 per cent methyl chloride, the solubility of the natural gas plays a minor part. Natural gas mixed with methyl chloride increases the apparent methyl chloride value obtained by the glacial acetic acid method, especially at low concentrations of methyl chloride.

Curve III, Fig. 2, is a methyl chloride-natural gas mixture saturated with water vapor. The discrepancy at low methyl chloride concentrations in this case is not so pronounced as in the methyl chloride-natural gas mixtures with little water vapor present.

Curve IV, Fig. 2, is a methyl chloride-air mixture saturated with water vapor. The repressive action of water vapor on the absorption of methyl chloride by glacial acetic acid is quite pronounced in this case.

In all these mixtures with a methyl chloride content of 40 per cent or more, the glacial acetic acid method gives fairly good results. With lower concentrations of methyl chloride the results are not so accurate.

THE PARTIAL PRESSURES METHOD OF DETERMINATION

An unmeasured sample of the effluent gas from the chlorination apparatus was introduced into the bulb of a low temperature fractionation and apparatus[1] and adjusted to atmospheric pressure which was recorded. The bulb was now cut off from the rest of the system, immersed in a liquid air-pentane bath below —135° C., and left for 10 min. The bulb was now connected with the Toepler pump and the methane pumped off. The bulb was cut off from the rest of the system again, the bath removed and the bulb allowed to come to room temperature and the vapor pressure read. As the sample contained only natural gas (which had been pumped off below —135° C.), methyl chloride and a small amount of water vapor (which was removed by having the bulb two-thirds filled with phosphorus pentoxide on glass wool), the ratio of the partial pressure of the methyl chloride to the total pressure at the start (barometer) gave the percentage of methyl chloride direct.

Fig. 3 gives the results of the partial pressures method plotted against the results of the glacial acetic acid method on the same sample.

THE COMBUSTION METHOD OF DETERMINATION

The methyl chloride was assumed to burn according to the reaction

$$CH_3Cl + 3/2O_2 = CO_2 + H_2O + HCl.$$

The sample was mixed with an excess of oxygen in an Orsat and subjected to slow combustion over a 5 per cent sodium hydroxide solution. The carbon dioxide and gaseous hydrochloric acid not absorbed by the sodium hydroxide were absorbed in the potassium hydroxide of the Orsat, without measuring, and the residual gas then returned to the burette and measured. The carbon dioxide and hydrochloric acid were absorbed by the sodium hydroxide and potassium hydroxide and the water condensed, leaving zero volume on the right side of the equation. This gives a total contraction of the left side of the equation or 5/2. The total contraction then, divided by 5/2, would give the methyl chloride which has been oxidized.

The sodium hydroxide solution was neutralized and

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[1] *Loc. cit.*

the hydrochloric acid absorbed was titrated with silver nitrate. One volume of methyl chloride should give one volume of hydrochloric acid.

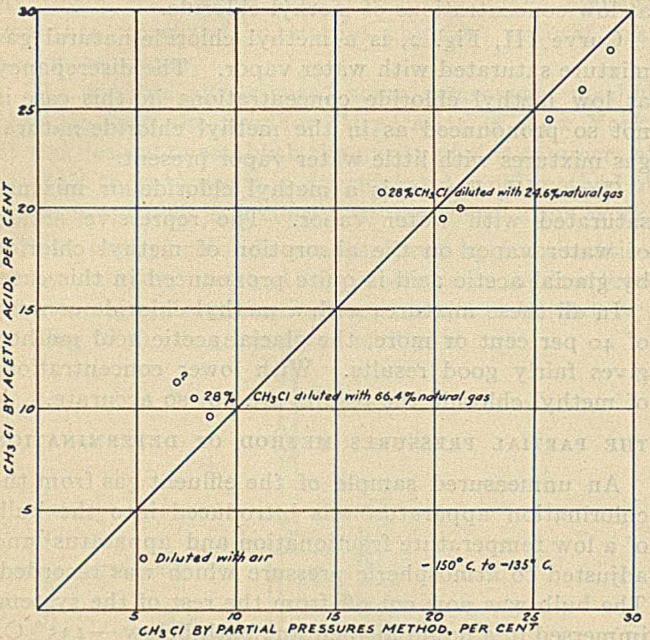

FIG. 3

On nine samples of the methyl chloride, the combustion data gave a value of from 86 per cent to 93.3 per cent. The hotter the platinum spiral in the combustion pipette, the greater the percentage of methyl chloride obtained. The corresponding values obtained by titrating the hydrochloric acid formed varied from 62.7 per cent to 79.8 per cent. This discrepancy may be due to part of the hydrochloric acid not being absorbed by the 5 per cent sodium hydroxide solution and later being absorbed by the potassium hydroxide pipette on the Orsat. This amount of hydrochloric acid would, therefore, not appear in the titration.

This method, moreover, is not suitable where other combustible gases are mixed with the methyl chloride.

CONCLUSIONS

The glacial acetic acid method is by far the most rapid method of determining methyl chloride in mixtures, and in mixtures with a methyl chloride content of 40 per cent or more, the results lie within the limits of experimental error. Below 40 per cent, the probable error of the determination is about 4 or 5 per cent.

Water vapor and air decrease the absorption of methyl chloride by glacial acetic acid.

The partial pressures method gives results on methyl chloride-natural gas mixtures comparing with the glacial acetic acid results on the same sample to a probable difference of 0.6 per cent.

The combustion method is not suitable on mixtures of methyl chloride with other combustible gases, and on pure methyl chloride the temperature required for complete combustion is too high for the platinum spiral to last long.

For control work on the chlorination process, where relative values only are required, the great rapidity and ease of manipulation of the glacial acetic acid method makes it the most desirable.

ACKNOWLEDGMENT

The authors wish to thank Dr. G. B. Taylor, Mr. G. W. Jones, and Mr. W. L. Parker for their valuable suggestions and assistance in this work.

BUREAU OF MINES
WASHINGTON, D. C.

EQUILIBRIUM STUDIES UPON THE BUCHER PROCESS

By J. B. FERGUSON AND P. D. V. MANNING

Received April 19, 1919

The solution of the many-sided problem of nitrogen fixation required the carrying out of a number of researches, and at the request of the Nitrate Division of the Ordnance Department, the Geophysical Laboratory of the Carnegie Institute undertook, with the coöperation of that Division, several of these investigations, one of which was a study of the Bucher process. In this work the Nitrate Division was represented by Mr. Manning.

The so-called Bucher process[1] consists essentially in heating a mixture of sodium carbonate, carbon, and iron in an atmosphere of nitrogen. The rôle of the iron is generally assumed to be purely catalytic, and according to Bucher the equation for the reaction may be written

$$2Na_2CO_3 + 4C + N_2 \rightleftarrows 2NaCN + 3CO. \qquad (1)$$

In his original article, Bucher states that at moderate temperatures, such as 900° to 950° C., the process may be operated using producer gas instead of pure nitrogen without loss in efficiency, provided that the product be not allowed to cool in the producer gas. The validity of this assertion seemed to be questioned by several results obtained during the operation of semi-commercial plants and for this reason we were asked to determine, if possible, the influence of carbon monoxide in the furnace gases upon the yield of sodium cyanide.

The character of this influence may be seen from the following theoretical considerations: Assuming, as Bucher has done, that the reaction involves only the two salts, sodium carbonate and sodium cyanide, and knowing that these salts when melted together form a homogeneous liquid,[2] and also that at temperatures at or above 950° C. metallic iron is the stable phase[3] in the presence of equilibrium mixtures of carbon monoxide, carbon dioxide, and carbon, then the phases present at equilibrium at these temperatures will be iron, carbon, a liquid phase and a gas phase. The components are iron, carbon, nitrogen, sodium, and oxygen, and hence from the application of the phase rule in its simplest form[4] the degrees of freedom are three in number. This means that if the temperature and pressure be fixed, variations in the composition of the gas phase must be accompanied by corresponding variations in the composition of the liquid phase and *vice versa*. Thus the yield of cyanide will be directly dependent upon the composition of the gas phase present during the operation of the process. The magnitude of the variations in the composition

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[1] THIS JOURNAL, 9 (1917), 233.

[2] Unpublished results of Dr. E. Posnjak of this laboratory.

[3] Hilpert and Dreckmann, *Ber.*, **48** (1915), 1281–6.

[4] $P + F = C + 2$.

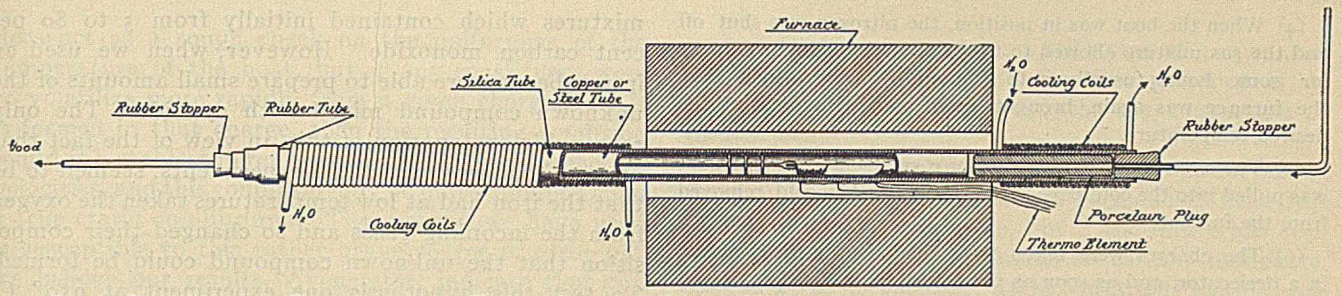

FIG. 1—CROSS SECTION OF FURNACE USED FOR HEATING CARBONATE-CYANIDE-IRON-CARBON CHARGE IN CURRENT OF CO-CO_2-N_2 MIXTURE

of one phase caused by given variations in the composition of the other phase is not indicated by the phase rule and Bucher evidently thought that at temperatures as high as 950° C. the deleterious effect of the presence of considerable percentages of carbon monoxide in the furnace gases was inappreciable. But the complicated relations which exist at equilibrium are in no wise indicated by Equation 1. In addition to nitrogen and carbon monoxide, the vapor phase must contain carbon dioxide,[1] sodium or an oxide of sodium, and sodium cyanide,[2] and possibly other substances as well. Similarly, in addition to sodium carbonate and sodium cyanide, the liquid phase must contain carbon dioxide, carbon monoxide, nitrogen, and some excess sodium;[3] the exact form of combination of the sodium is unknown, but probably most of it is present as oxide. The calculation of the equilibrium constant for the gaseous or for the liquid phase can only be made if we know the concentration of all of the reacting constituents of the phase in question. Thus if we assume that the reaction in the vapor phase is represented by the equation

$$2\mathrm{Na} + 2\mathrm{C} + \mathrm{N_2} \rightleftarrows 2\mathrm{NaCN} \qquad (2)$$

the equilibrium constant will be defined by the equation

$$K = \frac{C^2_{\mathrm{NaCN}}}{C^2_{\mathrm{Na}} \cdot C_{\mathrm{N_2}}} \qquad (3)$$

and no matter how small the values of C_{NaCN} or C_{Na} may be, unless they are constant they cannot be neglected. In the liquid phase the relations are much more complex and here also the concentration of the various constituents, regardless of their magnitude, cannot be neglected unless they are constant. The determination of the equilibrium constants is, therefore, probably unattainable experimentally. In view of this situation our problem resolves itself into the determination of certain empirical relations which may be considered a measure of the actual equilibrium conditions, and we therefore set out to determine the variations in the amount of the alkali in a charge which was converted at equilibrium to cyanide, with known variations in the composition of the gas stream passing over the charge.

For this purpose boat experiments were thought best suited and the apparatus used is shown in Fig. 1. The furnace was one especially designed for the production of uniform temperature in a central region 12 to 15 cm. in length, and has been previously described elsewhere.[1] The temperatures were measured by means of a differential platinum-platinrhodium thermoelement with a suitable potentiometer set-up. The outer tube of silica was protected by an inner tube of copper or iron from the fluxing action of the furnace vapors.[2] For the quantitative studies the copper tube was used. The boat was made of iron, 12 cm. in length, divided transversely into two compartments, and was welded to a small, steel rod which served as a means of inserting or withdrawing it. The baffles on the rod and the porcelain plug in the other end of the furnace tube all served to reduce the end heat-losses from the furnace. In front of the boat in the metal tube was placed some pure charcoal which was intended to reduce any carbon dioxide formed in the gas mixtures at the lower temperatures and to ensure that the gas mixture passing over the charge contained carbon monoxide and carbon dioxide in equilibrium proportions.

The charges were made up by mixing together sodium cyanide or sodium carbonate (Squibb's reagents) with carbon and iron, at first in varying amounts and finally in the proportions 3 of carbonate (or cyanide) : 1 of carbon : 1 of iron, by weight. The carbon used was pure untreated gas-mask charcoal furnished us from the supply at the American University Experiment Station of the Chemical Warfare Service. The iron was a hydrogen-reduced product obtained from Merck and was preheated at 800° C. in a vacuum for several hours to remove hydrogen.

The gas mixtures were prepared from commercial (Linde) nitrogen from which the oxygen had been removed, and pure carbon monoxide prepared by the sulfuric acid-formic acid method. Before such mixtures entered the furnace they were carefully dried with sulfuric acid and phosphorus pentoxide. They were kept in gasometers over mercury. The procedure was as follows:

(1) The furnace was brought up to temperature with the empty boat inserted and a slow stream of nitrogen flowing through.

(2) The boat was pulled into the cold portion of the tube and when cooled, removed.

(3) The boat was filled with the charge or charges as desired, and slowly inserted into the furnace, a gradual heating reducing the danger of the charge being carried out of the boat by the gases released at the high temperatures.

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[1] Carbon monoxide dissociates to form carbon dioxide according to the equation $2\mathrm{CO} \rightleftarrows \mathrm{CO_2} + \mathrm{C}$.

[2] Bucher and others have shown that sodium cyanide is volatile at temperatures in the neighborhood of 1000° C.

[3] Sodium carbonate is supposed to dissociate according to the equation $\mathrm{Na_2CO_3} \rightleftarrows \mathrm{Na_2O} + \mathrm{CO_2}$, but the relations which obtain at small $\mathrm{CO_2}$ pressures have not been thoroughly investigated.

[1] J. B. Ferguson, *Phys. Rev.*, **12** (1918), 81.

[2] E. Posnjak and H. E. Merwin, *J. Wash. Acad. Sci.*, **9** (1919), 28.

(4) When the boat was in position, the nitrogen was shut off and the gas mixture allowed to flow slowly through the furnace for some hours (usually 3 to 5 hours) during which time the furnace was again brought up to and maintained at the desired temperature.

(5) The experiment having run for a sufficient time, the boat was pulled into the cold part of the tube and when cold, removed from the furnace.

(6) The charges were taken from the boat, bottled, placed in a desiccator, and as soon as possible after removal examined microscopically. Later, chemical analyses of the charges were made, for which purpose aqueous extracts of the charges were used. These analyses consisted in most cases in determining the cyanide by the Lundell[1] method in which nickel ammonium sulfate and di-methyl-glyoxime are used and the total alkali by titration with standard sulfuric acid, using methyl orange as an indicator. Cyanates were sometimes tested for by boiling the solution with an excess of sulfuric acid and determining this excess with standard alkali, using methyl orange as an indicator. The difference between this latter titration and the direct titration with acid should represent approximately twice the amount of cyanate present.[2] In several experiments tests were made for free alkali. This was done by determining, in addition to the cyanate and cyanide, the carbonate, and then getting by difference from the total alkali the alkali not present in the form of these salts. The carbonate was determined by precipitation with barium chloride with suitable precautions.

Experiments at 950° to 1000° C. with concentrations of carbon monoxide as high as 80 per cent did not cause any change in the iron boat, thus confirming the observations of Hilpert and Dreckmann who found that iron was stable in the presence of equilibrium mixtures of carbon monoxide and carbon dioxide at these temperatures.

After several experiments it was found necessary to remove the protecting metal tube and clean it, as the sublimate which condensed in the colder portions of the tube interfered with the movement of the boat. This sublimate, when gas mixtures containing carbon monoxide were used, was always mainly sodium carbonate, but when pure nitrogen was used was sodium cyanide. The amount of this sublimate appeared to be greater when sodium carbonate was in the initial charge than when cyanide only was present, and this indicates that the alkali present in the vapor phase is only partly there in the form of cyanide. In some experiments evidence of the presence of sodium vapor was obtained but the evidence is not conclusive, as an equilibrium condition may not have existed in these experiments. These observations indicate that appreciable amounts of cyanide and alkali are probably present in the vapor phase at equilibrium.

Posnjak and Merwin[3] found that when the process was carried out in a copper tube in the laboratory the product was essentially a mixture of carbonate and cyanide, but that the sinters prepared commercially contained mainly an unknown compound. The former observation using pure nitrogen has been confirmed by us at 950° and 1000° C. and also with gas mixtures which contained initially from 5 to 80 per cent carbon monoxide. However, when we used an iron tube we were able to prepare small amounts of the unknown compound mixed with cyanide. The only reasonable explanation of this, in view of the fact that an iron boat was used in all experiments, seemed to be that the iron had at low temperatures taken the oxygen from the incoming gases and so changed their composition that the unknown compound could be formed. To test this hypothesis one experiment at 950° C. using a copper tube and an initial gas containing but 1.9 per cent of carbon monoxide was made. The initial mixture placed in the boat was a pure cyanide mixture and after four hours was found to contain definite traces of the unknown compound. This compound would, therefore, appear to form very slowly in the presence of low concentrations of carbon monoxide and carbon dioxide.

The presence of cyanates in the liquid phase could not be proved, even when high concentrations of carbon monoxide were used, by either the microscopic or chemical methods, but charges containing carbonate always contain also some free alkali. One charge was found to contain as high as 5 per cent free alkali and the commercial sinters often contain even higher percentages.

TABLE I—RESULTS OF COPPER TUBE EXPERIMENTS AT 1000° C.

Expt. No.	Initial Charge	Initial Gas Per cent	A Cyanide Titration Cc.	B Total Alkali Titration Cc.	Cyanide Conversion = 100 × A/B Per cent
1	Carbonate	CO = 5 N_2 = 95	8.2	2 × 5.2	79
	Cyanide	CO = 5 N_2 = 95	9.9	2 × 6.1	81
2	Carbonate	CO = 7.2 N_2 = 92.8	9.2	12	77
3	Carbonate	CO = 15.3 N_2 = 84.7	10.8	15.4	70
4	Carbonate	CO = 19.1 N_2 = 80.9	5.8	9	64
5	Carbonate	CO = 48 N_2 = 52	3.7	6.4	58
	Cyanide	CO = 48 N_2 = 52	8.1	13.6	60
6	Carbonate	CO = 47 N_2 = 53	2.4	4.0	60
7	Carbonate	CO = 81.5 N_2 = 18.5	3.4	14.1	24
	Cyanide	CO = 81.5 N_2 = 18.5	1.5	8.3	18

TABLE II—RESULTS OF COPPER TUBE EXPERIMENTS AT 946° C.

Expt. No.	Initial Charge	Initial Gas Per cent	A Cyanide Titration Cc.	B Total Alkali Titration Cc.	Cyanide Conversion = 100 × A/B Per cent
1	Cyanide	CO = 4.5 N_2 = 95.5	8.8	11.8	75
2	Cyanide	CO = 9.5 N_2 = 90.5	6.4	9.8	65
3	Cyanide	CO = 16.9 N_2 = 83.1	3.9	6.6	59
	Carbonate	CO = 16.9 N_2 = 83.1	2.9	5.6	52
4	Cyanide	CO = 48 N_2 = 52	3.5	12.3	28
	Carbonate	CO = 48 N_2 = 52	2.1	7.7	27

The same liquid phase could be obtained with a given gas mixture, but different initial solids. Thus when the boat was filled with two mixtures, one in each section (a pure carbonate and a pure cyanide mixture) and the gas stream allowed to flow over the charges for a sufficient time (about 5 hrs.), the charges appeared to be identical both by microscopic and by chemical tests. Were it not for the volatile nature of some of the constituents, this result might be taken as absolute proof that an equilibrium condition had been reached. It

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[1] Lundell and Bridgman, THIS JOURNAL, 6 (1914), 554.

[2] Cyanates are decomposed by strong acids like hydrochloric or sulfuric to form ammonia and carbon dioxide. The small amount of cyanic acid which may form when sulfuric acid is used would not interfere appreciably with this test.

[3] *J. Wash. Acad. Sci.*, 9 (1919), 28.

does act as a rough check on the uniformity of the temperature of the boat, but if any constituent were to volatilize more rapidly from a given charge than it is formed in that charge, then the resulting condition found is a stable one representing a balance of reaction velocities, and this condition may be quite different from a true static equilibrium. The method we have used is susceptible to this rather grave source of error but we believe our results, given later, indicate that the errors involved in its use are not of any great magnitude. Our quantitative results are given in Tables I and II. In these tables the column headed "Initial Gas" gives the composition of the gas mixture as made up, the "Titrations" are actual titrations in cubic centimeters, and the "Percentage Conversion" is the weight percentage of the total sodium carbonate which has been converted into cyanide.

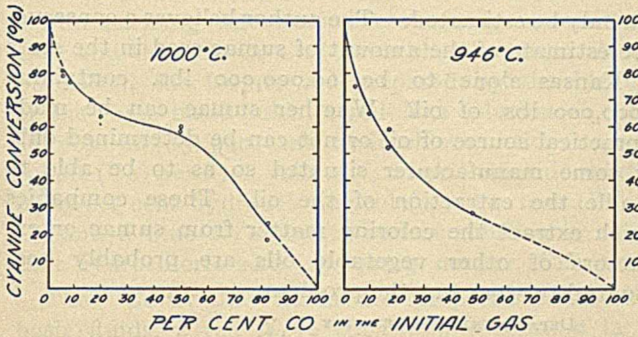

Fig. 2—Relation between Cyanide Conversion and Percentage of Carbon Monoxide in Initial Mixture at 1000° and 946° C.

In Fig. 2 the percentage conversions given in Tables I and II are plotted against the carbon monoxide content of the initial gas upon the assumption that no complications occur at very high or very low concentrations of carbon monoxide. This assumption must involve some error at low concentrations, since under these conditions some of the unknown compound is formed, and may also not be justified at the high concentrations, although the error here is probably less than at low concentrations.

The following interesting deductions relative to commercial cyanide processes[1] may be made from the location of these curves:

(1) The effect of temperature upon the possible yield of cyanide (yield at equilibrium) is relatively small at small concentrations of carbon monoxide, but if producer gas containing say 30 per cent carbon monoxide were used, would be an important factor.

(2) At 1000° C. producer gas can be used with a possible conversion of 63 per cent. A higher temperature would probably increase this conversion[2] but even at 1000° the advantages gained through the use of producer gas might more than offset the smaller conversion due to the use of producer gas in place of pure nitrogen.

(3) The presence of 15 per cent carbon monoxide in the initial mixture causes a reduction of 30 per cent in the conversion at 1000° C. The presence of 60 per cent carbon monoxide reduces the conversion to 50 per cent.

Therefore, if the initial gas contains carbon monoxide in small amounts, efforts should be made to keep this content as small as possible, but if the initial gas contains relatively large amounts of carbon monoxide, such as 25 or 30 per cent, slight variations in this content will have little effect upon the yield.

The mechanism of the reaction was conceived by Bucher to consist first in the reduction of the sodium carbonate by carbon to form sodium and, second, the reaction of this sodium with carbon and nitrogen to form cyanide. The first stage may well be the controlling one.

Now the rôle played by the carbon in this stage may be merely to control the carbon dioxide pressure and ensure that it is kept well below the dissociation pressure of the carbonate. The equilibrium between carbon monoxide, carbon dioxide, and carbon is very dependent upon both the temperature and the total pressure, so if our speculations even approximate the truth one would expect the yield of cyanide to be less dependent upon the temperature when referred to a carbon dioxide basis than when referred to a carbon monoxide basis. In Fig. 3 are curves showing the variation of the cyanide conversion with the carbon dioxide content of the gas phase. The results of Rhead and Wheeler[1] were used to calculate the carbon dioxide content from the carbon monoxide content, but their work did not extend to the low pressures and the curves are, therefore, only approximately correct. They do bear out, to a considerable extent, the speculations in which we have just indulged.

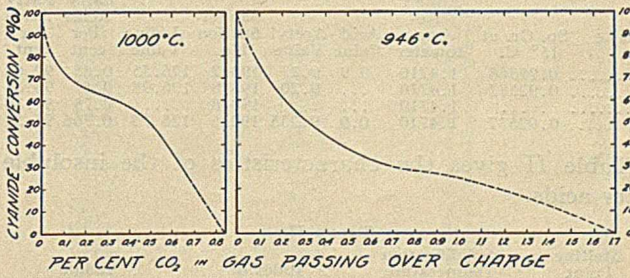

Fig. 3—Relation between Cyanide Conversion and Percentage of Carbon Dioxide in Gas Passing over Charge (Gas Consisting of Equilibrium Mixture of CO and CO_2 Together with Nitrogen)

The microscopic examinations were made by Dr. H. E. Merwin of this laboratory, and thanks are due him for his generous assistance.

SUMMARY

Experiments were made on the Bucher process using pure chemicals and mixtures of pure nitrogen and carbon monoxide in known proportions. Curves have been obtained showing (1) the relation between the carbon monoxide content of the furnace gases and the yield of cyanide, and (2) the relation between the carbon dioxide content of the furnace gases and the yield of cyanide, both at two temperatures. The

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[1] If a process involves components in addition to those considered by us, this fact must be borne in mind in the application of our results to such cases, in which quite different yields might be obtained.

[2] Bucher's ideas regarding the use of producer gas were probably based upon experiments in which the temperatures of the charge were not accurately known.

[1] *J. Chem. Soc.*, **99** (1911), 1140.

curves indicate that under certain conditions producer gas may be used in the process and that the dissociation of sodium carbonate is probably one of the controlling chemical reactions.

Carnegie Institution of Washington
Geophysical Laboratory
Washington, D. C.

A STUDY OF THE OIL FROM SUMAC (RHUS GLABRA)

By H. W. Brubaker

Received April 24, 1919

Since the demand for fats has increased so greatly and their price has reached such a high level it has become imperative that we make use of all the available sources of this most important material. A great deal of the rocky wasteland of Kansas and other states is covered with the common sumac (*Rhus Glabra*). It occurred to the author to make a chemical study of the oil from the sumac seed to determine its fitness as a food or for industrial purposes and the amount available.

The berries from which this oil was obtained were gathered at Manhattan, Kansas, in February 1919. The husks were removed from the berries by rubbing gently in a mortar and sending the material through a small fanning mill. The clean, air-dried seeds were ground in a mill and the fat extracted with dry ether in a continuous extraction apparatus large enough to hold 2 or 3 lbs. of the material. Two determinations gave an average of 11.71 per cent of oil in the ground seeds. Table I summarizes the results of the physical and chemical examination of the oil.

Table I

Sample No.	Sp. Gr. at 15° C.	Index of Refraction at 20° C. Abbé's Refractometer	Acid Value	Acetyl Value	Saponification No.	Iodine Value	Soluble Fatty Acids Per cent	Insoluble Fatty Acids Per cent
1.......	0.92568	1.4710	0.9	9.27	193.2	126.55	0.85	92.68
2.......	0.92587	1.4710	...	9.20	193.8	126.98	0.67	93.55
3.......	.....	1.4710	...	....	190.8	....	0.78	94.38
Av......	0.92577	1.4710	0.9	9.235	192.6	126.76	0.766	93.54

Table II gives the characteristics of the insoluble fatty acids.

Table II

Melting Point Deg. C.	Solidification Temperature Deg. C.	Index of Refraction	Iodine Value
17	6	1.470	121.8

The oil of sumac has a mild odor, pleasant taste, and a deep yellow color. It is quite viscid at ordinary room temperature. Upon being cooled it thickens gradually until at —16° C. it has the consistency of soft vaseline. The oil was not cooled to its freezing point; G. B. Frankforter and A. W. Martin give the freezing point of the oil from *Rhus Glabra* gathered in Minnesota as —24° C.[1]

Table III

Oil Tested	Percentage Increase in Weight in 7 Days of a Thin Film of Oil	Rise in Temp. on Treatment with Concd. H_2SO_4 Initial Temp. Deg. C.	Highest Temp. Deg. C.
Linseed oil..........	9.30	20	94
Sumac oil...........	1.66	20	70
Cottonseed oil.......	0.65	20	55

These authors also found an iodine value of 87 which differs materially from that found for the Kansas oil, 126.76. The high iodine value would indicate that the oil should have fairly good drying qualities. This conclusion is substantiated by the results of comparative tests shown in Table III.

A small amount of the oil mixed into a paste of the consistency of paint with sublimed white lead and spread on a plate of glass dried completely in three days.

The oil saponifies readily, giving a sodium soap of semisolid consistency.

It seems fair to conclude from the above study that sumac oil compares favorably in properties with other vegetable oils such as cottonseed oil and corn oil. It might readily find a use as an edible oil or in the soap-making industry or as a semidrying oil in the paint industry, if it can be put on the market at a reasonable cost. The amount which might be made available can only be estimated. The author believes a conservative estimate of the amount of sumac seed in the state of Kansas alone to be 60,000,000 lbs. containing 6,000,000 lbs. of oil. Whether sumac can be made a practical source of oil or not can be determined only by some manufacturer situated so as to be able to handle the extraction of the oil. Those companies which extract the coloring matter from sumac or extractors of other vegetable oils are probably best situated to work out the problem.

Department of Chemistry
Kansas State Agricultural College
Manhattan, Kansas

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[1] *Am. J. Pharm.*, **76** (1904), 151.

COLOR STANDARDS FOR COTTONSEED OIL

By H. V. Arny, Charlotte Kish and Frances Newmark

Received April 21, 1919

As is commonly known, the commercial grading of cottonseed oil is largely a matter of color, and much work has been done in attempting to find an ideal standard for the color of this commodity.

The glasses of the Lovibond tintometer have been largely used for this purpose, but I. G. Priest of the Bureau of Standards has shown[1] that out of 219 glasses borrowed from cotton oil concerns and tested by him, 9 per cent of the red glasses between 0.1 and 3.0 were not matches against the Bureau of Standard sets; 51 per cent of the red glasses between 4.0 and 20.0 were not matches; 14 per cent of the yellow glasses between 0.1 and 3.0 were not matched; and 40 per cent of the yellow glasses between 4.0 and 20.0 were not matched.

This report shows that the Lovibond apparatus is not the ideal standard upon which to base a country-wide valuation of cottonseed oil. Priest, in turn, attempted to solve the problem of authentic samples of cottonseed oil enclosed in sealed vacuum cells of the proper shape and dimensions to be examined in a colorimeter. While it is known that the color of cottonseed oil is susceptible to change when exposed to the air, Priest's preliminary experiments led him to the conclusion that a sample inclosed in a sealed vacuum cell would not be thus altered. The test of time, however, showed that such changes did take place and

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[1] *Proc. Soc. Cotton Products Analysts*, **1913**, p. 6.

he reported (in an address before the International Cotton Seed Crushers Association, June 7, 1916) that after 15 to 25 wks. the color of his samples changed 1 point red on the Lovibond scale when viewed in a $5\frac{1}{4}$-in. cell.

One of us has interested himself in standardized colored fluids since 1911[1] and having become convinced regarding the uniformity, permanency, and simplicity of the acid cobalt-ferric-copper solutions (the "Co-Fe-Cu" fluids) and of the ammoniacal cobalt-chromate-copper solutions (the "Co-Cr-Cu" fluids) devised by him, he enlisted the services of Miss Charlotte Kish and Miss Frances Newmark, in carrying out during the past year the experiments reported below. While there were some difficulties encountered in the work, he feels justified in stating that in his opinion the matching of cottonseed oil with the standardized fluids is entirely feasible.

Summarizing information concerning the "Co-Fe-Cu" and the "Co-Cr-Cu" fluids that has been already published, the former are prepared by the blending of the three basic fluids, a red $N/2$ solution of cobalt chloride in 15 per cent hydrochloric acid (14.74 g. cobalt (Co) per l.), a yellow $N/2$ ferric chloride solution in 15 per cent hydrochloric acid (9.308 g. iron (Fe) per l.), and a blue $N/2$ copper sulfate solution in 15 per cent hydrochloric acid (15.8925 g. copper (Cu) per l.).

The "Co-Cr-Cu" fluids are prepared from three basic fluids, a red $N/10$ cobaltamine solution in 2.8 per cent ammonia water (2.9485 g. cobalt (Co) per l.), a yellow $N/10$ ammonium chromate solution in 2.8 per cent ammonia water (0.8666 g. chromium (Cr) per l.), and a blue $N/10$ cuprammonium sulfate solution in 2.8 per cent ammonia water (3.1785 g. copper (Cu) per l.). It is obvious that the three basic fluids of either sets can be blended in any imaginable proportion, giving a variety of hues limited only by the tints of the basic fluids themselves.

TABLE I—COTTONSEED OIL SAMPLES, NO. 1

Lovibond readings in $\frac{1}{2}$-in. cells
Lovibond glasses: red, No. 200; yellow, No. 510; blue, No. 1180

Prime White	Red	Yellow	Blue
Dec. 1917	0.10 + 0.09	1.0 + 0.4 + 0.2	....
Feb. 1918	0.20	1.0 + 0.4 + 0.1	....
Apr. 1918	0.10 + 0.05	1.0 + 0.2 + 0.05	....
Oct. 1918	0.2	1.0 + 0.2	....
Choice Summer Yellow			
Dec. 1917	1.0	5.0 + 4.0 + 2.0 + 0.1	....
Mch. 1918	1.0	5.0 + 4.0 + 2.0 + 0.1 + 0.05	0.1
Apr. 1918	1.0	5.0 + 4.0 + 2.0 + 0.1	0.09
Oct. 1918	1.0	5.0 + 3.0	—0.1[1]
Off. Summer Yellow			
Dec. 1917	1.0 + 0.5 + 0.2 + 0.1	5.0 + 4.0 + 3.0 + 2.0 + 1.9	—0.39[1]
Mch. 1918	1.0 + 0.5 + 0.2 + 0.1	5.0 + 4.0 + 3.0 + 2.0 + 1.8 + 1.0 + 0.4	—0.4[1]
Apr. 1918	1.8	5.0 + 4.0 + 3.0 + 2.0 + 1.8 + 1.0 + 0.04 + 0.01	—0.4[1]
Oct. 1918	1.6	5.0 + 4.0 + 3.0 + 2.0 + 1.3 + 1.0	—0.2[1]

[1] The minus values mean that to secure a perfect match, it was necessary to place blue glasses of the value designated in front of the cell containing the oil that was being tested.

In commencing the work, a study of the keeping qualities of the fluids was first taken up and it was with much gratification that we found that samples prepared four years before had not faded to any perceptible degree, as readings with the same Lovibond glasses that we have used during six years showed. In all our work we have used these same Lovibond glasses as our empiric standards in fixing the color value of our fluids and in examining the fluids to note whether they lose color on standing. Readings of our fluids with our batch of Lovibond glasses are found in the *Druggists Circular*, **57** (1914), 131, and in the *Journal of the Franklin Institute*, **180** (1915), 199.

In fact, the "Co-Fe-Cu" and the "Co-Cr-Cu" tints are less prone to change in color than are the three samples of oil examined thus far, the Lovibond readings at different periods of the first set of samples being given in preceding table.

Table I shows that one of the difficulties confronting us arose from the fact that the oils that we were to standardize as to color had a shifting value: a variation distinctly more than the basic color variation dependent on light conditions.

After establishing the Lovibond value of the standard commercial samples that we were to study, we turned to the tables of color values of our fluids published in the *Druggists Circular* and in the *Journal of the Franklin Institute* and there found that none of these were matches, being darker than "prime white" and lighter than "Off. summer yellow." All of the "Co-Cr-Cu" blends were much more green than the oil samples but the "Co-Fe-Cu" blends gave promise of matches on proper dilution and we, therefore, made several hundred dilutions of these fluids and present in Table II some data showing the possibilities of color matching with the fluids.

TABLE II—PRIME WHITE OIL APPROXIMATELY MATCHED IN 1-OZ. ROUND BOTTLES THE BLENDS SHOWN

	$N/2$ Acidulated Ferric Chloride Cc.	$N/2$ Acidulated Cobalt Chloride Cc.	Water Sufficient to Make Cc.
I*a*	15.5	0.8	50
II*a*	15.5	0.9	50
III*a*	15.5	1.0	50
IV*a*	15.7	1.0	50
V*a*	15.9	1.0	50
VI*a*	15.9	0.8	50
VII*a*	15.9	1.1	50
VIII*a*	16.0	1.0	50
IX*a*	16.1	1.0	50
X*a*	16.3	1.0	60
XI*a*	16.3	1.1	60
XII*a*	16.4	1.0	60
XIII*a*	16.5	1.0	60
XIV*a*	16.5	1.0	65
*XV*a*	16.0	1.4	60
*XVI*a*	16.0	1.5	60
XVII*a*	16.0	1.2	60
XIX*a*	16.2	1.2	60
XX*a*	16.3	1.4	60
*XXI*a*	16.0	1.3	60

The best matches in Blake bottles (indicated by asterisks in Table II) were XV*a*, XVI*a*, and XXI*a*, and these were submitted to a Lovibond reading with results given in Table III.

TABLE III—LOVIBOND READINGS OF MATCHING FLUIDS

	Red	Yellow	Blue
XV*a*	0.1	1.0 + 0.4 + 0.2 + 0.1	......
XVI*a*	0.2	1.0 + 0.4 + 0.1	......
XXI*a*	0.09	1.0 + 0.4 + 0.2 + 0.1	......

Compared with the oil reading in Table I, it will be seen that all of these are good matches.

It must be also specially noted that $N/2$ acidulated ferric chloride solution was not sufficiently yellow to match the color of the oil, so a N acidulated solution (18.616 g. iron (Fe) per l.) had to be employed.

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[1] See notably *J. Frank. Inst.*, August 1915, p. 199, and THIS JOURNAL, **8** (1916), 309.

TABLE IV—CHOICE SUMMER YELLOW APPROXIMATELY MATCHED IN 1-OZ. ROUND BOTTLES THE BLENDS SHOWN

	N Acidulated Ferric Chloride Cc.	*N*/2 Acidulated Cobalt Chloride Cc.	Water Enough to Make Cc.
I*b*	33.3	3.5	50
II*b*	33.3	3.3	50
III*b*	33.0	3.6	50
IV*b*	34.0	3.4	50
V*b*	33.0	3.8	50
*VII*b*	32.4	4.0	50
*XI*b*	31.5	4.0	45
*XII*b*	31.0	4.4	45

The best matches in Blake bottles (indicated by asterisks in Table IV) were VII*b*, XI*b*, and XII*b*, which give, in $^1/_2$-in. cells, the Lovibond readings shown in Table V.

TABLE V—LOVIBOND READINGS OF THE MATCHING FLUIDS

	Red	Yellow	Blue
VII*b*	0.9	5.0 + 4.0 + 2.0 + 0.4	...
XI*b*	1.0	5.0 + 4.0 + 2.0 + 1.0 + 0.2	—0.1
XII*b*	1.0	5.0 + 4.0 + 2.0 + 0.3	—0.1

Again, comparison of these figures with the Lovibond reading of the oil sample in Table I shows a fairly good match.

TABLE VI—OFF. SUMMER YELLOW APPROXIMATELY MATCHED IN 1-OZ. ROUND BOTTLES THE BLENDS SHOWN

	N Acidulated Ferric Chloride Cc.	*N*/2 Acidulated Cobalt Chloride Cc.	Water Enough to Make Cc.
I*c*	40.0	5.0	55
II*c*	38.0	4.5	50
III*c*	37.0	4.2	50
IV*c*	45.0	6.1	60
*V*c*	42.0	5.7	60
*VI*c*	42.0	6.0	60
*VII*c*	42.0	6.2	60
VIII*c*	40.0	6.0	60
IX*c*	41.0	5.5	60
X*c*	41.5	6.0	60

The best matches in round bottles (indicated by the asterisks in Table VI) were V*c*, VI*c*, and VII*c*, and Table VII shows the Lovibond readings of these.

TABLE VII—LOVIBOND READINGS OF THE MATCHING FLUIDS

	Red	Yellow	Blue
V*c*	1.0 + 0.5	5 + 4 + 3 + 2 + 1.8 + 1.2	—0.45
VI*c*	1.0 + 0.6 + 0.08	5 + 4 + 3 + 2 + 1.8 + 1.5 + 0.3	—0.4
VII*c*	1.0 + 0.5 + 0.3	5 + 4 + 3 ± 2 + 1.8 + 1.5	—0.4

Comparison with the Lovibond readings of the sample of oil found in Table I will show that all of these are fairly good matches.

This work was checked up in the cases of all three samples of the oil and of the matching fluids in the Lovibond tintometer, the oil sample being placed in one $^1/_2$-in. cell and the matching fluid in another at its side. The results obtained coincided with those obtained with 1-oz. round bottles. More exact matching was then tried in the Kober colorimeter but the results were unsatisfactory, due primarily to the color changes occurring in the oil.

TABLE VIII—COTTONSEED OIL SAMPLES, NO. 2. LOVIBOND READINGS IN $^1/_2$-IN. CELL

	Red	Yellow	Blue
Prime White	0.4	1.9	......
Choice Summer Yellow	1.0	5 + 4 + 2 + 1.9 + 0.2	......
Off. Summer Yellow	1.3	5 + 4 + 3 + 1.6	......

TABLE IX—COTTONSEED OIL SAMPLES, NO. 3. LOVIBOND READINGS IN $^1/_2$-IN. CELL

	Red	Yellow	Blue
Prime White	0.1	0.4 + 0.2	......
Choice Summer Yellow	0.7 + 0.2	5 + 1.3	......
Off. Summer Yellow	2.2	5 + 4 + 3 + 2 + 1	......

This preliminary work proved, however, the practicability of matching the color of cottonseed oil with the colored fluids; so two new sets of oil samples were obtained, and with the experience gained in the preliminary work, the finding of entirely satisfactory matches became a simple matter.

Of the fluids prepared for comparison with these oils those given in Table X were approximate matches and for the sake of uniformity (not obtaining in the original fluids given in Table II) all were prepared on the basis of 50 cc. of finished product. In Table X both proportions of blend and Lovibond readings are given.

TABLE X

PRIME WHITE

	N/2 Acidulated Ferric Chloride Cc.	*N*/2 Acidulated Cobalt Chloride Cc.	Water Enough to Make Cc.	Lovibond Readings $^1/_2$-In. Cells		
				Red	Yellow	Blue
24*a*	14.0	1.5	50	0.2 + 0.1	1.9	....
27*a*	11.2	1.4	50	0.2	1.0 + 0.4 + 0.2	....
28*a*	15.0	0.8	50	0.2	1.8	....
29*a*	15.0	0.7	50	0.2	1.9	....
31*a*	15.0	1.5	50	0.2 + 0.1	1.8	....
39*a*	14.5	1.5	50	0.2 + 0.1	2.0	....
41*a*	8.0	0.4	50	0.2	1.0	....
42*a*	6.0	0.4	50	0.1	0.7	....
CHOICE SUMMER YELLOW						
2*c*	33.3	3.3	50	0.7 + 0.1	5 + 4 + 3	....
3*c*	33.0	3.6	50	0.7 + 0.2	5 + 4 + 3	....
4*c*	34.0	3.4	50	0.7 + 0.1	5 + 4 + 3 + 0.4 + 0.2	....
19*c*	33.5	4.0	50	1.0	5 + 4 + 3 + 0.7	....
20*c*	33.5	4.2	50	0.7 + 0.2	5 + 4 + 3 + 0.7	....
21*c*	33.3	4.4	50	1.0 + 0.1	5 + 4 + 3 + 0.7	....
22*c*	30.0	2.6	50	0.4 + 0.1	5 + 4 + 2	....
23*c*	28.0	2.8	50	0.4 + 0.1	5 + 4 + 1	....
24*c*	26.0	3.0	50	0.4 + 0.2	5 + 4	....
25*c*	24.0	3.0	50	0.4 + 0.1	5 + 3	....
26*c*	23.0	3.2	50	0.7 + 0.06	5 + 2	....
27*c*	22.0	3.4	50	0.7 + 0.1 + 0.08	5 + 1.6	....
28*c*	21.5	3.6	50	0.7 + 0.2 + 0.05	5 + 1.3 + 0.1	....
29*c*	21.0	4.0	50	1.0 + 1.0	5 + 1.3	....
30*c*	20.5	4.0	50	1.0 + 0.1	5 + 1 + 0.2	....
31*c*	20.5	3.8	50	1.0	5 + 1	....
32*c*	21.5	3.4	50	0.7 + 0.2	5 + 1.3 + 0.1	....
33*c*	25.5	3.0	50	0.7	5 + 3 + 0.2 + 0.1	....
34*c*	25.0	3.0	50	0.7	5 + 3 + 0.2	....

OFF. SUMMER YELLOW

	N Acidulated Ferric Chloride Cc.	*N*/2 Acidulated Cobalt Chloride Cc.	*N*/2 Acidulated Copper Sulfate Cc.	Water Enough to Make Cc.			
11*b*	39.0	4.5	...	50	1 + 0.1	5 + 4 + 3 + 2	....
14*b*	38.0	6.0	...	50	1.3 + 0.1	5 + 4 + 3 + 1.6	....
16*b*	38.0	7.0	...	50	1.5 + 0.2	5 + 4 + 3 + 1.6	....
17*b*	38.0	6.0	2.0	50	1.3	5 + 4 + 3 + 1.6	....
19*b*	38.5	6.0	3.0	50	1 + 0.2	5 + 4 + 3 + 1.8	....
20*b*	39.0	8.0	...	50	2 + 0.4 + 0.2	5 + 4 + 3 + 2 + 1	....
21*b*	39.0	7.2	...	50	2 + 0.4	5 + 4 + 3 + 2 + 1	....

Comparison of the Lovibond figures in Table X with the Lovibond readings of Samples 2 and 3 in Tables VIII and IX show that the readings of Prime White Oil No. 2 approximate the readings of Fluids 27*a* and 39*a*; that Choice Summer Yellow Oil No. 2 is in fair agreement with Fluids 2*c*, 3*c*, and 4*c*; that Off. Summer Yellow Oil No. 2 checks up with Fluids 11*b*, 14*b*, and 19*b*; that Prime White Oil No. 3 resembles Fluid 42*a*; that Choice Summer Yellow Oil No. 3 was like Fluids 27*c* and 28*c*; that Off. Summer Yellow Oil No. 3 was matched by Fluids 20*b* and 21*b*. The six oil samples were then subjected to critical comparison with the resembling fluids, as well as a number of the others enumerated above, (*a*) in round 1-oz. bottles, (*b*) in two $^1/_2$-in. cells in the Lovibond instrument, (*c*) in the Kober colorimeter. The results of this critical comparison are tabulated below.

TABLE XI

PRIME WHITE NO. 2

In 1-oz. round bottles matched *39a*
In Lovibond apparatus matched *39a*
In Kober colorimeter matched (30 mm. layer against 30 mm. layer) *39a*

CHOICE SUMMER YELLOW NO. 2

In 1-oz. round bottles matched *2c* and *4c*
In Lovibond apparatus matched *2c*
In Kober colorimeter matched *2c* (30 mm. layer against 30 mm. layer) and *4c* (30 mm. layer against 28 mm. layer)

OFF. SUMMER YELLOW NO. 2

In 1-oz. round bottles matched *11b* and *14b*
In Lovibond apparatus matched *14b*
In Kober colorimeter matched *19b* (30 mm. layer against 30 mm. layer)

PRIME WHITE NO. 3

In 1-oz. round bottles matched *42a*
In Lovibond apparatus matched *42a*
In Kober colorimeter matched *42a* (30 mm. layer against 30 mm. layer)

CHOICE SUMMER YELLOW NO. 3

In 1-oz. round bottles matched *27c*
In Lovibond apparatus matched *27c*
In Kober colorimeter matched *27c* (30 mm. layer against 30 mm. layer) and *28c* (30 mm. layer against 28 mm. layer)

OFF. SUMMER YELLOW NO. 3

In 1-oz. round bottles matched *20b* and *21b*
In Lovibond apparatus matched *21b*
In Kober colorimeter matched *21b* (30 mm. layer against 30 mm. layer)

In most of the Kober readings matching of 40 mm. layers gave same results as 30 mm. layers.

SUMMARY AND CONCLUSIONS

I—The greatest difficulty in standardizing the color of cottonseed oil is the variation of the tint of commercial samples. This is shown by the matched difference in the Lovibond readings (using the same Lovibond glasses in each case) of Samples 1, 2, and 3 as given in Tables I, VIII, and IX, which is all the more surprising as the color values (expressed in the now accepted Lovibond units) given by those kindly furnishing the samples are in practical agreement as far as Prime White and Choice Summer Yellow are concerned.

II—This discrepancy may be due to the variation in the tint of the supposed standard Lovibond glasses (as pointed out by Mr. Priest) or to alteration of the color of the oil samples (see Table I) or to both causes.

III—Further study of the "Co-Fe-Cu" standardized colored fluids confirms the stability of the tints obtained on blending.

IV—The facts that they can be prepared by anyone competent to conduct quantitative analysis, that when made of proper strength their color values are uniform, and that their employment saves the cost of expensive appliances commend them to the practical men.

V—In matching cottonseed oil with these standardized fluids (as shown in Table XI) approximately good matches are obtained when the oil samples and the fluids are compared in 1-oz. round bottles, while practically perfect results are secured by comparing the oil samples with the fluids in $^{1}/_{2}$-in. cells placed side by side in the Lovibond instrument. In fact, in our work we found such matches not only more easily secured, but in some respects even more satisfactorily obtained, than when the more expensive colorimeter was used.

VI—As shown in Tables III, V, VII, and XI, the Prime White samples were matched by blends ranging from 6 cc. *N*/2 acidulated ferric chloride solution, 0.4 cc. *N*/2 acidulated cobalt chloride solution, and water enough to make 50 cc. to 16 cc. *N*/2 acidulated ferric chloride solution, 1.4 cc. *N*/2 acidulated cobalt chloride solution, and water enough to make 60 cc.; Choice Summer Yellow samples were matched by blends ranging from 22 cc. *N* acidulated ferric chloride solution, 3.4 cc. *N*/2 acidulated cobalt chloride solution, and water enough to make 50 cc. to 33.3 cc. *N* acidulated ferric chloride solution, 3.3 cc. *N*/2 acidulated cobalt chloride solution, and water enough to make 50 cc., while Off. Summer Yellow samples were matched by blends ranging from 42 cc. *N* acidulated ferric chloride solution, 6.2 cc. *N*/2 acidulated cobalt chloride solution, and water enough to make 60 cc. to 39 cc. *N* acidulated ferric chloride solution, 7.2 cc. *N*/2 acidulated cobalt chloride solution, and water enough to make 50 cc. Whether the limits of color should be fixed between narrower boundaries is a problem to be decided by the standards committee of the Society of Cotton Products Analysts.

In closing, the authors wish to extend their thanks to Messrs. David Wesson, F. N. Smalley, and G. Worthen Agee for samples of oil and for suggestions kindly given.

COLLEGE OF PHARMACY
COLUMBIA UNIVERSITY
NEW YORK CITY

THE TINCTURE OF VANILLA OF THE NATIONAL FORMULARY

By BERNARD H. SMITH

Received April 29, 1919

Tincture of vanilla was discontinued in the 9th Edition of the Pharmacopoeia, being transferred to the 4th Edition of the National Formulary. The method of the 8th Edition of the Pharmacopoeia called for the use of 65 per cent alcohol, which is generally recognized as being higher than is necessary to produce the best vanilla extract, but otherwise the procedure was practicable and workable. The same cannot be said of the substituted method, which is as follows:

TINCTURE OF VANILLA
(U. S. P. VIII)
Tr. Vanill.

Vanilla, cut into small pieces, one hundred grams........	100 g.
Sugar, in coarse granules, two hundred grams..........	200 g.
Alcohol................................	.....
Diluted Alcohol...........................	.....
Water, each, a sufficient quantity..................	.....
To make one thousand milliliters..................	1000 mils.

Macerate the vanilla with five hundred milliliters of alcohol in a stoppered container, in a moderately warm place, for two days with frequent agitation; then transfer it to a plain filter and reserve the filtered liquid. Spread out the drug on the filter and expose it to the air until all of the alcohol has evaporated. Then grind the vanilla and sugar to a uniform powder, pack this in a percolator and slowly percolate it with a mixture of the reserved filtrate and an equal volume of water. When the liquid ceases to drop, continue the percolation slowly, gradually adding the remainder of the prepared menstruum and then sufficient diluted alcohol to make the product measure one thousand milliliters.

It will be noticed that the new method calls for a preliminary extraction with alcohol which contains not less than 94.9 per cent of alcohol by volume; in other words, "Cologne spirits" of commerce. Alcohol of this strength removes a resinous extractive from the beans which is precipitated in the form of a persistent cloud when the menstruum is diluted and which is not subsequently removed by percolation or by any ordinary method of filtration. This colloidal material adds nothing to the flavor of the extract, but on the other hand renders it unsightly and unsalable.

Another obvious disadvantage of the proposed method is the loss of alcohol which its use entails. Vanilla beans of average moisture content will retain 10 per cent of the alcohol used when placed upon a filter to drain, which is lost if the directions are followed to expose the drug "to the air until all of the alcohol has evaporated."

The method would seem to be of greater academic interest than of practical value, which is unfortunate, inasmuch as the authorities having the enforcement of the food and drug laws in charge naturally attach great importance to official methods of procedure.

Baker Extract Company
Springfield, Mass.

THE DETERMINATION OF BROMIDE IN MINERAL WATERS AND BRINES[1]

By W. F. Baughman and W. W. Skinner

The chief sources of bromine in the United States are natural and artificial brines in which it is present as bromide associated frequently with small amounts of iodide. Bromine is obtained by appropriate treatment of the mother liquor, or "bittern," obtained as a by-product in the manufacture of common salt. Owing to the increased demand for bromine resulting in a greatly increased market value during the period of the war, search has been made for new supplies of brine rich in bromide. The authors had occasion to examine a number of samples of brines and desired to determine their bromide content.

The colorimetric methods have been studied by the Association of Official Agricultural Chemists[2] and by Sweeney and Withrow,[3] but are not entirely satisfactory. In these methods the bromide solution is treated with chlorine water or some other oxidizing agent and the liberated bromine absorbed in carbon disulfide, chloroform, carbon tetrachloride, etc., and compared with suitable standards. Where the bromine present in the sample taken for the determination is greater than 5 mg., however, only approximate results can be obtained by these methods.

A search of the literature revealed no method which could confidently be relied upon to give correct results for bromine associated with the other constituents usually found in brines, and it was necessary to attempt the development of a satisfactory method.

The literature contains many methods for the selective oxidation of bromides in the presence of chlorides and the subsequent removal of the liberated bromine by steam distillation or by aspiration. Vortman[1] recommended the use of lead peroxide (PbO_2) and acetic acid, the liberated bromine being removed by distillation. Cavazzi[2] recommended barium dioxide (BaO_2) and dilute sulfuric acid. Engel[3] made the assertion that ammonium persulfate ($(NH_4)_2S_2O_8$) and sodium acetate ($NaC_2H_3O_2$) will liberate bromine and not chlorine at a temperature of 70–80° C. Berglund[4] used a mixture of potassium bisulfate ($KHSO_4$) and potassium permanganate ($KMnO_4$) in the cold, and removed the bromine by aspiration. He found, however, that if sodium chloride were present in excess of 1 g., a small amount of chlorine would be set free along with the bromine. To overcome this difficulty he recommended two aspirations, the first to concentrate the bromine content in a suitable absorbing solution from which the bromine is again liberated by potassium bisulfate and potassium permanganate and removed by aspiration, resulting in pure bromine being obtained. Baubigny and Rivals[5] stated that copper sulfate ($CuSO_4$) and potassium permanganate ($KMnO_4$) will liberate at room temperature bromine and not chlorine unless chloride is present in too large amount. Wyss[6] used ferric sulfate ($Fe_2(SO_4)_3$) and potassium permanganate ($KMnO_4$). White[7] used aluminum sulfate ($Al_2(SO_4)_3$) and potassium permanganate ($KMnO_4$). Jannasch and Aschoff[8] used acetic acid and potassium permanganate ($KMnO_4$). Bugarsky,[9] Benedict and Snell,[10] and Andrews[11] suggested the use of iodic acid. Gooch and Blumenthal[12] used selenic acid, and Gooch and Cole[13] telluric acid.

The possibility of obtaining a clean separation of bromine and chlorine by the use of most of these methods is dependent upon the concentration of the chloride or of the oxidizing agent, or of the acidity of the solution. They are effective, therefore, only within narrow limits of concentration of the reacting solution and the possibility always exists that either owing to the addition of too much acid or oxidizing agent, or from the solution becoming too concentrated during distillation, some chlorine will be set free, or, the contrary conditions prevailing, all of the bromine will not be liberated.

The double aspiration recommended by Berglund disposes of the possibility of bromine being contaminated with chlorine, but it seems to have been overlooked or not approved by later investigators who

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[1] Read before the Division of Water, Sewage, and Sanitation of the American Chemical Society, at the 57th Meeting, Buffalo, April 7 to 11, 1919.

[2] *J. A. O. A. C.*, [I] **1** (1915), 97.

[3] This Journal, **9** (1917), 671.

[1] *Z. anal. Chem.*, **25** (1886), 172.

[2] *Gazz. chim. ital.*, **13**, 174.

[3] *Compt. rend.*, **118** (1894), 1263.

[4] *Z. anal. Chem.*, **24** (1885), 184.

[5] *Compt. rend.*, **125** (1897), 527, 607.

[6] *Repert. anal. chem.*, **5** (1885), 238.

[7] *Chem. News*, **57** (1888), 233.

[8] *Z. anorg. Chem.*, **1** (1892), 144.

[9] *Ibid.*, **10** (1895), 387.

[10] *J. Am. Chem. Soc.*, **25** (1903), 809.

[11] *Ibid.*, **29** (1907), 275.

[12] *Am. J. Sci.*, **35** (1913), 54.

[13] *Ibid.*, **37** (1914), 257. See also Cole, *Ibid.*, **38** (1914), 265.

by the methods proposed seem to have sacrificed accuracy and reliability of results to rapidity of procedure.

Bugarsky[1] has pointed out another possible source of error in case the bromide is removed by distillation caused by the formation of a small amount of hydrobromic acid (HBr) from steam and bromine. Consequently, if the liberated bromine is driven out by distillation, it should be determined gravimetrically and not iodimetrically.

Wyss,[2] recognizing the uncertainty of results obtained by methods already recommended, suggested a method which he thought would dispose of the possibility, theoretical or practical, of results being vitiated by the liberation of chlorine. He makes the statement that in the presence of free chromic acid in excess, "chlorine in the native state will be found as chromyl chloride which at room temperature is not volatile and not dissociated," and asserts that if any chlorine is set free it will combine with the chromic acid.

His procedure is substantially as follows:

Chlorides and bromides, which should be contained in a minimum of solution, are treated with an excess of chromic anhydride (CrO_3) (about 15 g.) and a few cubic centimeters of hydrogen peroxide (H_2O_2), and the liberated bromine removed by aspiration at room temperature, absorbed in a potassium iodide (KI) solution, and titrated with thiosulfate. His recommendation, however, is supported by only seven experiments which are considered not sufficiently comprehensive to substantiate it. It was, therefore, decided to subject this proposed method to a more thorough investigation.

REAGENTS

SODIUM CHLORIDE (NaCl)—This was purified as described in a previous paper on the determination of iodide.[3]

POTASSIUM BROMIDE (KBr)—A quantity of potassium bromide (C. P. reagent) was recrystallized several times from distilled water and carefully dried. A solution was prepared by dissolving an accurately weighed amount in distilled water. Upon standardizing gravimetrically by precipitating and weighing as silver bromide, a figure for the bromine content was obtained which agreed within a few tenths of a milligram with that calculated from the quantity of potassium bromide weighed out.

CHROMIC ANHYDRIDE (CrO_3)—This was a C. P. reagent which contained a small quantity of sulfuric acid. Check analyses were made and it was determined that the small quantity of sulfuric acid usually found in chromic anhydride does not affect the accuracy of the result.

HYDROGEN PEROXIDE (H_2O_2)—The ordinary 3 per cent U. S. P. article of commerce was used (free of acetanilide).

POTASSIUM IODIDE—The salt used for the absorption solution was also a C. P. reagent which was tested and found to be free from iodate.

THIOSULFATE SOLUTION—This was standardized against pure iodine which had been resublimed twice from a small quantity of potassium iodide.

APPARATUS

Three tall-form, 250 cc. glass-stoppered, Drechsel gas washing bottles or cylinders were joined together in series, the first two by welding together the outlet tube of the first and the intake tube of the second, and the second and third by rubber tubing, bringing the ends of the two glass tubes as close together as possible. (The third bottle need not be a Drechsel wash bottle, but may be constructed from any kind of a suitable bottle at hand.) In the first, the bromine is liberated and its removal by aspiration is facilitated by filling the cylinder to about half its capacity with glass beads. It was found convenient in order to easily force the intake tube down through the beads to make the end of the tube somewhat pointed. A small funnel was joined by a rubber connection to the outside vertical end of the intake tube so as to make possible the introduction of liquids after the cylinder was closed.

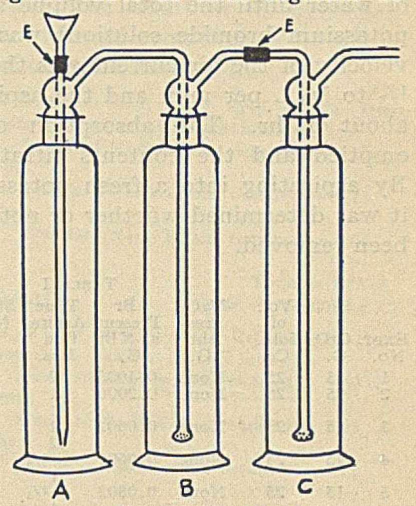

Fig. 1—Apparatus
A—Reaction Cylinder. B and C—Absorption Cylinders. E—Rubber Connections

The other two cylinders contain the liquid for absorbing the bromine. The lower end of the intake tube of each cylinder was blown into a little ball, the horizontal circumference of which was pierced by fine holes in order to break up the bubbles. It was found that only a very small part of the bromine escapes from the first absorption cylinder, so it is safe to connect it with the second only by a rubber tube, provided the edges of the two tubes are close fitting.

In a former paper[1] concerning the determination of iodide in mineral waters and brines, the authors suggested a method for removing iodide from the sample to be used for the bromide determination. In the present paper it is assumed that iodide has either been removed, as previously indicated, or that it is not present in amounts sufficient to interfere with the bromide determination. The latter assumption often proves to be a fact in the case of brines.

EXPERIMENTAL WORK

The action of chromic anhydride on a bromide in solution was investigated first. This reaction is represented by the following equation:

$$2CrO_3 + 6HBr = Cr_2O_3 + 3H_2O + 3Br_2$$

The reaction cylinder was charged first with a layer of glass beads about 1 in. in thickness, then

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[1] *Loc. cit.*

[2] *Med. Klinik*, **24** (1910), 288.

[3] This Journal, 11 (1919), 563.

[1] *Loc. cit.*

with 15 g. of dry chromic anhydride, and finally enough glass beads to half fill the cylinder. The first absorption cylinder contained 10 g. of potassium iodide dissolved in 200 cc. of water, and the second, 3 or 4 g. potassium iodide in a like volume. After charging, the cylinders were joined together and a slow current of air drawn through. A measured volume of the standard potassium bromide solution was then added to the reaction cylinder through the small funnel mentioned and the funnel washed with a small amount of water until the total volume added (including the potassium bromide solution) was about 25 cc. The velocity of the air current was then increased to from 1/2 to 3/4 l. per min. and the aspiration continued for about 1 hr. The absorption cylinders were then emptied and the contents titrated with thiosulfate. By aspirating into a fresh potassium iodide solution, it was determined whether or not all the bromine had been removed.

TABLE I

Expt. No.	CrO_3 G.	Vol. of Soln. Cc.	NaCl Present G.	Br Present as KBr G.	Time Aspiration Hrs.	Standard[2] $Na_2S_2O_3$ Soln. Cc.	Bromine Found G.	Error G.
1	15	25	None	0.1003	2	12.62	0.1000	—0.0003
2	15	25	None	0.2006	1 1	25.33 0.07	0.2012	+0.0006
3	15	25	None	0.0602	1 2	7.50 0.10	0.0602	0.0000
4	15	25	None	0.0602	3/4 1	7.60 0.00	0.0602	0.0000
5	15	25	None	0.0802	3/4 1	10.12 0.00	0.0802	0.0000
6	15	25	2.0	0.0000	3		Faint trace	
7	15	25	5.0	0.0000	3		Faint trace	
8	15	25	10.0	0.0000	3		Faint trace	
9	15	25	0.5	0.0602	1 2	7.60 0.00	0.0602	0.0000
10	15	25	0.6	0.0602	1 3	7.60 0.00	0.0602	0.0000
11	15	25	0.6	0.0602	1 3	7.62 0.00	0.0603	+0.0001
12	15	25	1.0	0.0602	1 1	7.63 0.00	0.0604	+0.0004
13	15	25	2.0	0.0602	1 2	7.65 0.01	0.0607	+0.0005
14	15	25	3.0	0.0602	1 2	7.68 0.05	0.0612	+0.0010
15	15	25	4.0	0.0602	1 2	7.55 0.18	0.0612	+0.0010
16	15	25	5.0	0.0602	1 1[1] 2 1	5.75 1.60 0.36 0.00	0.0611	+0.0009
17	15	25	6.0	0.0602	1 1 1 1[1] 1	3.32 2.40 1.08 1.10 0.10	0.0634	+0.0032
18	15	25	8.0	0.0602	2 1 1/2 1[1] 2 2	4.40 1.40 2.10 0.03 0.03	0.0630	+0.0028
19	15	25	10.0	0.0602	2 1 1/2 1[1] 2 3	3.00 1.05 3.30 0.15 0.10	0.0602	0.0000
20	15	25	5.0	0.0201	1 2	2.24 0.30	0.0201	0.0000
21	15	25	5.0	0.0281	2 2	3.50 0.08	0.0284	+0.0003
22	15	25	5.0	0.0401	2 2	4.90 0.20	0.0404	+0.0003
23	15	25	5.0	0.0080	2 2	1.00 0.03	0.0082	+0.0002
24	15	25	5.0	0.0160	2 2	1.92 0.10	0.0160	+0.0000

[1] Stood over night before this aspiration.

[2] 1 cc. = 0.00792 g. bromine.

The results obtained are the first five in Table I. It will be noted that they are very satisfactory, those of Expts. 3, 4, and 5 agreeing exactly with the theory. The bromine was usually removed completely by aspirating for about 1 hr.

Expts. 6, 7, and 8 show the action of chromic anhydride on a solution of sodium chloride. A very faint trace of iodine was liberated in the potassium iodide solution which, after 3 hrs. aspiration, was equivalent to not more than 0.1 mg. of bromine. When, however, the solution of sodium chloride and chromic anhydride was allowed to stand over night and then aspirated, using a fresh potassium iodide solution, slightly more iodine was liberated, an amount equivalent to about 1 mg. of bromine. That this was due to the action of chromic anhydride on sodium chloride and not to chromic acid carried over mechanically was proven by aspirating a solution containing only chromic anhydride. Not a trace of iodine was liberated. Therefore, if the sodium chloride were free from bromine, and it is believed from the precautions taken it can be assumed that it contained no trace of bromine, then chromic anhydride will, at room temperature, liberate a trace of chlorine from chloride, especially if allowed to act for a considerable length of time.

In Expts. 9 to 24, mixtures of sodium chloride and potassium bromide were used. A measured volume of the potassium bromide solution was added to a weighed quantity of sodium chloride in a small dish, water added if necessary to dissolve the sodium chloride, and the solution then evaporated nearly to dryness. A few glass beads were added to the reaction cylinder, then the mixture of sodium chloride and potassium bromide scraped in as completely as possible, and then beads added until the cylinder was half full. After connecting the cylinders and starting the aspiration, 15 g. chromic anhydride dissolved in 10 to 12 cc. water were added to the reaction cylinder, followed by washings from the evaporating dish which had contained the mixed chloride and bromide sufficient to bring the total volume added to about 25 cc. as before.

Bromine was determined in the presence of 0.5 or 0.6 g. sodium chloride with very satisfactory results. But when the quantity of sodium chloride was increased to 1 g. or more, the results for bromine were too high, showing that some chlorine was liberated. The results show that more chlorine is liberated from a mixture of chloride and bromide than from solutions of pure sodium chloride, that is, the presence of bromide decreases the stability of sodium chloride toward chromic anhydride. This is similar to the observation of Berglund[1] concerning the action of potassium bisulfate and potassium permanganate on solutions of mixtures of chloride and bromide and to our experience concerning the action of ferric sulfate on solutions of mixtures of iodide and bromide.[1] In the latter case we showed that while ferric sulfate would not liberate bromine from a pure bromide solution below a certain concentration, yet if free iodine were present, bromine would be liberated and that free iodine decreased the stability of bromide toward ferric sulfate. Berglund explained his results by assuming that some chlorbromide was formed and this seems plausible, but is difficult to prove experimentally.

With increasing concentration of chloride, the rate of evolution of bromine decreases. In the absence

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[1] *Loc. cit.*

of a chloride, it is possible to remove all the bromine in 1 hr. or less. In Expt. 17 only about 89 per cent of the bromine was removed by 3 hrs. aspiration from a solution containing 6 g. of sodium chloride, assuming that all the halogen evolved was bromine, although it is probable that some of it was chlorine; in Expt. 18, about 87 per cent after $3^1/_2$ hrs. aspiration from a solution containing 8 g. of sodium chloride; and in Expt. 19, about 81 per cent after $3^1/_2$ hrs. aspiration from a solution containing 10 g. sodium chloride.

If the mixture of chromic acid, bromide, and chloride is allowed to react without aspirating for a considerable length of time, as over night, and then aspirated, the bromine comes over more rapidly. This is shown in Expts. 25 to 31, Table II. Also, more chlorine is liberated.

TABLE II—MIXTURE ALLOWED TO STAND OVER NIGHT BEFORE ASPIRATION

Expt. No.	CrO_3 G.	Vol. of Soln. Cc.	NaCl Present G.	Br Present as KBr G.	Time of Aspiration Hrs.	Standard[1] $Na_2S_2O_3$ Soln. Cc.	Bromine Found G.	Error G.
25	15	25	10	0.0802	1	9.45	0.0816	+0.0014
					3	0.6		
					$1^3/_4$	0.25		
26	20	20	10	0.0802	$1^1/_4$	11.62	0.0824	+0.0022
					2	0.05		
27	15	20	5	0.0602	$1^3/_4$	8.64	0.0684	+0.0082
28	20	20	10	0.0602	$1^1/_4$	8.54	0.0676	+0.0074
29	15	20	10	0.0000	1		Trace	
30	20	16	10	0.0000	3	0.05	0.0004	+0.0004
31	15	25	8	0.0602	$1^1/_2$	8.18	0.0649	+0.0047
					1	0.02		

[1] 1 cc. = 0.00792 g. bromine.

It is evident from these last experiments that free bromine can be readily removed by aspiration from a concentrated sodium chloride solution and that after the bromine is once set free, sodium chloride does not have a retarding influence on its removal. It is more likely that the decrease in the rate of evolution with increasing amounts of chloride present is due to the sodium chloride removing some of the chromic anhydride from the sphere of action, possibly by the formation of chromyl chloride (CrO_2Cl_2). Thus, due to the decreased concentration of the chromic anhydride, the bromide would be oxidized less readily. From a solution containing in 25 cc. 5 g. chromic anhydride and 0.0600 g. bromine as potassium bromide, only 22 per cent of the bromine was evolved after $3^1/_2$ hrs. aspiration. However, after standing over night, the remainder of the bromine was removed in about 2 hrs.

It is, therefore, clear that the use of chromic acid alone does not solve the problem of separating bromine and chlorine.

The influence of hydrogen peroxide as recommended by Wyss was next studied.

Upon the addition of hydrogen peroxide to a solution of chromic anhydride, a rapid evolution of oxygen takes place and the chromic anhydride is reduced to the insoluble chromic oxide (Cr_2O_3) according to the equation

$$2H_2CrO_4 + 3H_2O_2 = Cr_2O_3 + 2O_2 + 5H_2O.$$

When hydrogen peroxide is added to a solution of chloride, bromide, and chromic anhydride which is being aspirated into a potassium iodide solution, an effervescence occurs due to the oxygen formed and in a few seconds the iodine color in the potassium iodide solution begins to deepen rapidly. That this is due to bromine (or chlorine) liberated by the chromic anhydride and hydrogen peroxide was proven by treating a solution of chromic anhydride which contained no bromide or chloride with hydrogen peroxide in a similar manner. No iodine was liberated in the absorbing solution. The strong oxidizing influence is evidently due to the nascent oxygen.

An inspection of the records of Expts. 32 to 38, inclusive, will show that the addition of hydrogen peroxide increases the rate of evolution of bromine and also the amount of chlorine liberated.

EXPT. 32—8 G. NaCl, 0.0602 G. Br AS KBr, 15 G. CrO_3, 18 Cc. H_2O
Aspirated 1 hr., two 2-cc. portions H_2O_2 added at 20 min. intervals
Standard $Na_2S_2O_3$ soln. required = 7.55 cc.
Added 2 cc. H_2O_2, aspirated 2 hrs.
Standard $Na_2S_2O_3$ soln. required = 0.15
Added 2 cc. H_2O_2, aspirated 1 hr.
Standard $Na_2S_2O_3$ soln. required = 0.05
Total = 7.75 cc.
Bromine found = 0.0614 g. Error = +0.0012 g.

EXPT. 33—10 G. NaCl, 0.0602 G. Br AS KBr, 15 G. CrO_3, 18 Cc. H_2O
Aspirated 1 hr., two 2-cc. portions H_2O_2 added at 20 min. intervals
Standard $Na_2S_2O_3$ soln. required = 7.60 cc.
Added 2 cc. H_2O_2, aspirated 2 hrs.
Standard $Na_2S_2O_3$ soln. required = 0.23
Added 2 cc. H_2O_2, aspirated 1 hr.
Standard $Na_2S_2O_3$ soln. required = 0.15
Total = 7.98 cc.
Bromine found = 0.0632 g. Error = +0.0030 g.

EXPT. 34—10 G. NaCl, 0.0602 G. Br AS KBr, 15 G. CrO_3, 20 Cc. H_2O
Mixed and allowed to stand over night in reaction cylinder
Aspirated 2 hrs., three 2-cc. portions H_2O_2 added at 20 min. intervals
Standard $Na_2S_2O_3$ soln. required = 8.40 cc.
Aspirated 1 hr.
Standard $Na_2S_2O_3$ soln. required = 0.05
Added 2 cc. H_2O_2, aspirated $^1/_2$ hr.
Standard $Na_2S_2O_3$ soln. required = 0.10
Total = 8.55 cc.
Bromine found = 0.0677 g. Error = +0.0075 g.

EXPT. 35—10 G. NaCl, 0.0802 G. Br AS KBr, 15 G. CrO_3, 20 Cc. H_2O
Mixed and allowed to stand over night in reaction cylinder
Aspirated 2 hrs., three 2-cc. portions H_2O_2 added at 20 min. intervals
Standard $Na_2S_2O_3$ soln. required = 11.85 cc.
Aspirated 1 hr.
Standard $Na_2S_2O_3$ soln. required = 0.00
Added 2 cc. H_2O_2 and aspirated $^1/_2$ hr.
Standard $Na_2S_2O_3$ soln. required = 0.10
Total = 11.95 cc.
Bromine found = 0.0946 g. Error = +0.0144 g.

EXPT. 36—10 G. NaCl, 0.0602 G. Br AS KBr, 15 G. CrO_3, 20 Cc. H_2O, 2 Cc. H_2O_2
Mixed and allowed to stand over night in reaction cylinder
Aspirated 2 hrs., two 2-cc. portions H_2O_2 added at 20 min. intervals
Standard $Na_2S_2O_3$ soln. required = 7.99 cc.
Aspirated 1 hr.
Standard $Na_2S_2O_3$ soln. required = 0.00
Added 2 cc. H_2O_2, aspirated 1 hr.
Standard $Na_2S_2O_3$ soln. required = 0.10
Total = 8.09 cc.
Bromine found = 0.0641 g. Error = +0.0039 g.

EXPT. 37—10 G. NaCl, 0.0802 G. Br AS KBr, 15 G. CrO_3, 20 Cc. H_2O, 2 Cc. H_2O_2
Mixed and allowed to stand over night in reaction cylinder
Aspirated 2 hrs., two 2-cc. portions H_2O_2 added at 20 min. intervals
Standard $Na_2S_2O_3$ soln. required = 10.60 cc.
Aspirated 1 hr.
Standard $Na_2S_2O_3$ soln. required = 0.00
Added 2 cc. H_2O_2, aspirated 1 hr.
Standard $Na_2S_2O_3$ soln. required = 0.10
Total = 10.70 cc.
Bromine found = 0.0847 g. Error = +0.0045 g.

EXPT. 38—10 G. NaCl, No KBr, 20 G. CrO_3, 16 Cc. H_2O_2
Mixed and allowed to stand over night in reaction cylinder
Aspirated 3 hrs.
Standard $Na_2S_2O_3$ soln. required = 0.05 cc.
3 cc. H_2O_2 added, aspirated 1/2 hr.
Standard $Na_2S_2O_3$ soln. required = 0.10
Aspirated 1/2 hr.
Standard $Na_2S_2O_3$ soln. required = 0.00
3 cc. H_2O_2 added, aspirated 1/2 hr.
Standard $Na_2S_2O_3$ soln. required = 0.10

The assertion of Wyss that free chlorine in a solution of chromic anhydride will form chromyl chloride, which at room temperature is not dissociated and not volatile, and that, consequently, this principle may be used for separating chlorine and bromine, is not according to the experimental facts as we have found them. The method published by Wyss, therefore, is wholly unreliable.

The difficulties pointed out, however, can be overcome by using the double aspiration principle first suggested by Berglund in his bisulfate and permanganate method. The first aspiration serves to concentrate the bromine content in an absorbing solution which will change the free halogen to halide, the absorbing solution being subjected to a second treatment with chromic anhydride, resulting, on account of the small amount of chloride present, in pure bromine being evolved.

The results in Table III were obtained by employing double aspiration. The reaction cylinder was charged as before with glass beads, the sample to be examined, 15 g. chromic anhydride, and 25 cc. water. To the first absorption cylinder were added 20 cc. and to the second 5 cc. of a solution which contained in 25 cc. 1 g. sodium sulfite (Na_2SO_3) and 0.2 g. sodium carbonate (Na_2CO_3). Sufficient water was then added to each cylinder to bring the volume to about 200 cc. The sulfite reduces the bromine to bromide and the reaction may be represented by the following equation:

$$Na_2SO_3 + 2Br + H_2O = 2HBr + Na_2SO_4$$

The carbonate neutralizes the hydrobromic acid and prevents it from being volatilized during the subsequent evaporation. After connecting, the cylinders were aspirated for a short time until the contents of the reaction cylinder were thoroughly mixed. The small funnel on the reaction cylinder was then removed and the inlet tube of the cylinder closed by clamping a rubber tube over the end. In order to guard against a possible escape of bromine at the ground glass stopper of the reaction cylinder, the pressure in the apparatus was reduced by sucking out a little air after closing. The apparatus was then allowed to stand over night. In the morning, it was aspirated for about 3 hrs. and four portions of 2 cc. each of hydrogen peroxide added at half-hour intervals. The absorbing solution was then evaporated nearly to dryness, the residue dissolved in about 5 cc. of water and added, using 20 cc. water to wash the evaporating dish, to the reaction cylinder which had been previously charged with glass beads and chromic anhydride and connected with the absorption cylinders filled with potassium iodide solution. Aspiration was continued until all the bromine had been evolved (about 1 hr.), and the potassium iodide solution titrated with thiosulfate.

The results are considered very satisfactory and indicate that bromine may be determined in the presence of as much as 10 g. sodium chloride with a negative error of less than 1 mg. and no possibility of the results being vitiated by the liberation of chlorine.

TABLE III—DOUBLE ASPIRATION

EXPT. No.	NaCl Present G.	Br Present as KBr G.	Standard $Na_2S_2O_3$ Soln.[1] Cc.	Bromine Found G.	Error G.
39	None	0.0602	7.60	0.0602	0.0000
40	3	0.0642	8.00	0.0634	—0.0008
41	6	0.0602	7.52	0.0596	—0.0006
42	10	0.0602	7.52	0.0596	—0.0006
43	10	0.0802	10.10	0.0800	—0.0002
44	10	0.0802	10.00	0.0792	—0.0010
45	5	0.0591	7.42	0.0588	—0.0003
46	10	0.0591	7.40	0.0586	—0.0005
47	10	0.0985	12.40	0.0982	—0.0003
48	10	0.0788	9.94	0.0787	—0.0001

[1] 1 cc. = 0.00792 g. Br.

The procedure recommended for the determination of bromine in a mixture of bromide and chloride, using the apparatus already described, is as follows:

Evaporate the sample of water or brine, which should not be acid (if necessary, add small amount of sodium carbonate), to dryness or nearly so. Charge the reaction cylinder by introducing first glass beads to a depth of about 1 in., then as much of the sample as can be scraped in, and finally enough glass beads to fill the cylinder half full. Make a solution of sodium sulfite and sodium carbonate of such a concentration that 25 cc. will contain 1 g. of sulfite and 0.2 g. of carbonate. Add 20 cc. of this solution to the first absorption cylinder, 5 cc. to the second, and dilute each to approximately 200 cc. Connect the three cylinders and draw through a slow current of air. Add 15 g. chromic anhydride dissolved in 10 to 12 cc. water to the reaction cylinder, followed by washings from the evaporating dish which contained the sample, sufficient to bring the total volume added to about 25 cc. Aspirate until the contents of the reaction cylinder are in solution and thoroughly mixed, then discontinue, close the inlet tube with a small piece of rubber tubing and a clamp, and reduce the pressure in the apparatus slightly by sucking out some air in order to guard against any possible escape of bromine at the ground glass stopper. Allow to stand over night, then aspirate with a rather strong current of air (about 1/2 to 3/4 l. per min.) for 3 hrs., adding four 2-cc. portions of 3 per cent hydrogen peroxide at 30 min. intervals. Stop the aspiration and evaporate the contents of the two absorption cylinders nearly to dryness. Clean out the reaction cylinder and freshly charge with glass beads and 15 g. chromic anhydride. Into the first absorption cylinder, put 10 g. potassium iodide dissolved in 200 cc. of water, and into the second 3 or 4 g. in a like amount of water. Connect the apparatus, draw through a slow current of air, and transfer the contents of the evaporating dish to the reaction cylinder by means of the small funnel, using 25 cc. of water. Aspirate with a rather strong current of air until all the bromine is evolved (about 1 hr.) and titrate the potassium iodide solution with thiosulfate.

SUMMARY

Chromic acid in concentrated solution liberates bromine from bromides quantitatively at room temperature, and the bromine may be removed by aspiration. It liberates only a trace of chlorine from chlorides and forms probably chromyl chloride which remains in solution.

When chromic acid acts on a solution of chlorides and bromides, some chlorbromide is formed which is removed with the bromine by aspirating.

Details of a method making use of the principle of double aspiration are given for the determination of bromine in the presence of large amounts of chlorides.

WATER LABORATORY, BUREAU OF CHEMISTRY
WASHINGTON, D. C.

THE COMPOSITION OF THE FRUIT OF THE VIRGINIA CREEPER, AMPELOPSIS QUINQUEFOLIA

By GEORGE D. BEAL AND EDWARD A. GLENZ

Received February 28, 1919

Ampelopsis quinquefolia, family *Vitaceae*, is a climbing woody vine found in woods and thickets throughout the central portion of the United States and from Quebec to Manitoba in Canada. It is known variously as the Virginia creeper, American ivy, five-leaved ivy, woodbine, and false grape. The fruit consists of small, blue, one- to four-seeded berries, and is not edible. Some few cases of poisoning have been ascribed to it, but proof of its poisonous nature is lacking. The fluid extract of the leaves has been used medicinally.

The various methods for the extraction of the proximate constituents were carried out according to Parsons.[1] The solvents used were benzene, methyl alcohol, water, and sulfuric acid. After each extraction the residue was dried and weighed to determine the amount of material extracted.

BENZENE EXTRACT—100.6 g. of the air-dried fruit were extracted with benzene for 8 hrs. in a Soxhlet extractor. After evaporation of the benzene an oily extract remained, having a greenish brown color and possessing a somewhat aromatic odor. The extract amounted to 28.91 per cent. This contained a yellow oil and 0.394 per cent of a waxy substance insoluble in low boiling petroleum ether. The extract yielded 0.14 per cent of neutral ash.

METHYL ALCOHOL EXTRACT—The residue from the benzene extraction was extracted with methyl alcohol, sp. gr. 0.848, for 8 hrs. in a Soxhlet extractor. This extract had a purplish red color similar to that of grape juice, and after standing for some time deposited some green, solid matter. The total material extracted by the alcohol amounted to 21.1 per cent and was used in qualitative tests for the sugars and organic acids present.

COLD WATER EXTRACT—The residue after the alcohol extraction was macerated with cold water for 16 hrs., filtered, and after thorough washing with cold water was expressed. A neutral red solution was obtained, the water-soluble extractives amounting to 1.8 per cent.

SULFURIC ACID EXTRACT—After the water treatment, the residue was boiled under a reflux condenser for 1 hr. with 1 per cent sulfuric acid, and then macerated in the cold for 2 days. The mixture at no time gave a reaction for starch with iodine. A reddish purple, syrupy extract was obtained, containing 14.7 per cent of solids.

SUGARS—To avoid any discrepancies due to chemical change, the sugars were determined in a portion of the fresh fruit. At the time of gathering the sample 100 g. of the fresh berries were placed in a flask and covered with 300 cc. of 95 per cent alcohol, then allowed to stand until needed, being shaken two or three times per week. At the end of 5 mos. the mixture was boiled for 2 hrs. under a reflux condenser, filtered, and the treatment repeated two or three times with fresh portions of solvent, the last extract obtained being colorless. The combined extracts were evaporated *in vacuo* to a thick syrup and taken up with water. The solution was washed three times with ether to remove the green oily matter and the resulting cherry-red solution was clarified with lead subacetate and alumina cream. The filtrate was then made up to a volume of 2000 cc. and used for the various sugar determinations, while the precipitated lead compounds were a second source of material for the study of the organic acids.

The total reducing sugars were determined by the method of Defren-O'Sullivan both before and after inversion, and calculated as dextrose. The reducing sugar before inversion amounted to 9.97 per cent and after inversion to 12.29 per cent of the fresh fruit. The sucrose calculated from the increase in reducing power after inversion amounted to 2.26 per cent of the fresh fruit, while that determined by direct and invert polarization in another portion of the same extract by the Clerget method was found to be 2.22 per cent.

The amount of levulose as determined from polariscope readings at 20° and 60°, according to Wiley's formula,[1] was found to be 7.00 per cent, and the dextrose to be 3.67 per cent. Only one osazone could be obtained from the solution. When heated rapidly so that a temperature of 200° was reached in 3 min. it melted at 204° and was evidently glucosazone. This would indicate the absence of other osazone-forming sugars than dextrose and levulose.

ORGANIC ACIDS—In all, three different samples were used for the identification of the organic acids. The methyl alcohol extract was evaporated to a syrup, taken up with water, and the acids precipitated with lead subacetate and alumina cream. This precipitate and the precipitate used in the clarification of the sugar solution were used for the qualitative tests, reactions being obtained indicative of oxalic, malic, tartaric, citric, and tannic acids. For the quantitative determination a weighed quantity of the dried fruit was digested with 2 per cent hydrochloric acid for 1 hr. at the boiling temperature, and after filtering, clarified with boneblack. After concentrating the solution the method of Barfoed[2] was used for the separation. The results, calculated to the air-dry fruits, were oxalic acid 1.21 per cent, and citric acid 0.58 per cent.

OIL—The oil was the most interesting part of the whole fruit. As the plant belonged to the same family as the grape, we expected to find an oil similar to grape oil. The air-dried fruit was crushed between two boards and 100 g. of clean seeds picked out. These

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[1] *Am. Chem. J.*, 1 (1880), 377

[1] Wiley's "Agricultural Analysis," p. 272.

[2] *Z. anal. Chem.*, 7 (1868), 403.

were washed with low-boiling petroleum ether, the washings afterwards being used in the extraction, and carefully crushed in a mortar. They were extracted in a Soxhlet extractor with petroleum ether (b. p. 25°–40°) for 8 hrs., then ground to a fine powder and again extracted for 8 hrs. About half of the solvent was evaporated on the water bath and the evaporation completed in a current of carbon dioxide. The final traces of solvent were removed in a vacuum desiccator. Treated in this way the seeds yielded 25.6 per cent of oil.

The oil has the appearance of olive oil, perhaps slightly yellower, is odorless, and has only a slight taste, which reminds one of castor oil. After standing for a week a small amount of solid fat separated. At 0° C. the oil formed a pasty mass and solidified below that point. It responded to the elaidin test, forming a white solid and a brown liquid. A film of the oil dried in 14 days, although it had not even become tacky in 7 days. The absorption of oxygen, as measured by the increase in weight, was as follows:

First 70 hrs.	0.99 per cent
Second 70 hrs.	3.34 per cent

The oil gave the following analytical constants:

Saponification number	193
Iodine number, Hanus	90
Acid value	0
Unsaponifiable matter, per cent	1.67
Specific gravity, 15.5°	0.9239
Index of refraction, 15°	1.4761
Liquid fatty acids, Gusserow, per cent	84.0
Solid fatty acids, per cent	1.60
Iodine value of liquid acids	103.2
Iodine value of solid acids	53.4
Iodine value of mixed acids	96
Neutralization value of mixed acids	203
Mean molecular weight of mixed acids	275
Acetyl value of mixed acids	42.85
Neutralization value of liquid acids	170
Mean molecular weight of liquid acids	330

Making use of the scheme for the study of the mixed fatty acids given by Lewkowitsch,[1] it appears that the following solid acids are present: stearic, palmitic, lauric or myristic, and probably dihydroxystearic and isoöleic, while the liquid acids are oleic, ricinoleic, and linolic.

These properties of the oil which have been enumerated place it in the castor oil group of fatty oils, as will be seen by the following table:

	CASTOR	GRAPE	CROTON	AMPELOPSIS
Specific gravity	0.96	0.935	0.95	0.924
Refractive index	1.4799	1.4713	...	1.4762
Saponification number	183–186	178	210–215	186–194
Iodine number	83–86	96	102–104	86–90
Mixed fatty acids:				
Neutralization value	192	187	201	203
Iodine number	87–93	99	111	96
Molecular weight	293	299	279	275
Acids present:				
Tiglic	+		+	
Dihydroxystearic	+			+
Stearic	+	+	+	+
Palmitic		+	+	+
Myristic			+	
Lauric			+	+
Ricinoleic	+	+	+	+
Linolic	+	+		+
Oleic	+	+		+

UNIVERSITY OF ILLINOIS
URBANA, ILLINOIS

THE U. S. P. ASSAY OF MERCURIAL OINTMENT

By L. F. GABEL

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The method as given in the U. S. P. IX for the assay of mercurial ointment has proven unsatisfactory in that results by this method are variable and low. In the official assay the fats are extracted by the solvent action of purified petroleum benzine. The mercury is incorporated in the fats in a finely divided state and is separated by repeated washings with benzine. The mercury is so finely divided that it does not settle quickly in the benzine and the numerous decantations make it almost impossible to prevent the loss of part of the mercury. The manipulation required is also a factor to be considered.

With the view of replacing the official assay by a more accurate and expeditious method, comparative experimental determinations were made using three methods: (1) The U. S. P. assay; (2) the determination of mercury as mercury sulfide; (3) the proposed continuous extraction method.

In carrying out the sulfide method, the sample of ointment was treated with dilute nitric acid (1 : 2), digested, filtered, washed, and evaporated to dryness. After redissolving in hydrochloric acid (1 : 8), the general procedure of the U. S. P. sulfide method for the assay of mercuric chloride was followed.

The proposed method as given below is accurate and calls for the minimum amount of manipulation.

THE EXTRACTION METHOD

Extract several 11 cm. hardened filter papers (similar to Whatman's No. 50) with ether to remove fats, dry, and fold. Weigh a 5 to 10 g. sample of the ointment on one of these filter papers which has been previously tared. Place in a Soxhlet apparatus so that the top of the paper extends just above the arm of the outflow tube. This is easily adjusted by placing glass wool or absorbent cotton in the lower part of the Soxhlet apparatus. Extract with petroleum ether from 2 to 4 hrs. Dry and weigh.

Two samples of mercury ointment (U. S. P.) containing 30 per cent and 50 per cent of mercury were assayed by the three methods and the comparative results obtained are given in Table I.

TABLE I

SAMPLE Per cent Hg	U. S. P. Assay Per cent	Sulfide Method Per cent	Extraction Method Per cent
30	27.2	29.6	29.6
	29.2	30.0	30.3
	28.7	30.2	30.1
	26.5	....	30.5
50	48.9	49.6	49.8
	48.4	49.8	49.5
	48.0	....	49.6

It will be seen that the U. S. P. method gives results which are variably low, while the sulfide method and the extraction method both give results which are fairly accurate. Because of the ease of manipulation, the extraction method is preferable and it is recommended that this method be seriously considered for the next revision of the U. S. P.

It should be noted that the mercury left on the filter paper in the extraction method is readily collected into a globule and is easily examined for the presence of any appreciable amount of foreign material.

ANALYTICAL DEPARTMENT, PARKE, DAVIS & COMPANY
DETROIT, MICHIGAN

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[1] "Technology of Oils, Fats and Waxes," Ed. 5, Vol. 1.

LABORATORY AND PLANT

PREPARATION AND TESTING OF HYDROGEN OF HIGH PURITY

By Junius David Edwards

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In the course of a study of the properties of pure gases, the preparation of pure hydrogen by several different methods was undertaken. W. A. Noyes has already shown[1] in his work on the atomic weight of hydrogen, that hydrogen of exceptional purity could be prepared by the electrolysis of a solution of barium hydroxide. His work leaves little further to be said regarding the purity of hydrogen, which can be produced in that manner if the proper precautions are adopted. Where the highest purity is not essential, other methods may offer certain advantages. Chief of these is the greater speed with which hydrogen can be generated by such means as the reaction between zinc and acid or of hydrone (sodium-lead alloy) and water. For example, the maximum rate of generation from a small electrolytic cell taking 10 amp. is about 4.4 l. per hr., whereas 10 to 20 times that rate can be easily attained with a small-sized Kipp generator for relatively short periods of time.

The Kipp generator, however, has two disadvantages where purity of the product is the first requisite. The residual air must be swept out (which consumes time and material), and the acid is in contact with air in the upper reservoir; this air dissolving in the acid may slowly diffuse into and contaminate the hydrogen. To obviate these difficulties, the generator shown in Fig. 1 was designed by the author in coöperation with Mr. E. R. Weaver.

The operation of the generator is apparent from the figure. The chief advantages claimed for this generator are:

1—The sweeping-out period of generation is eliminated.

2—An atmosphere of pure hydrogen is maintained in all parts of the apparatus at all times.

3—Pure hydrogen can be obtained from the generator at any time—immediately after filling or after standing for long periods.

4—Fresh acid can be introduced without admitting air.

The manipulation by which this is accomplished is as follows: Before filling the apparatus it is first evacuated through *a*. The residual pressure in the generator is indicated by the height of the mercury in the tube *d* which serves as a manometer and also as a blow-off. Any leak can thus be detected by the indications of this manometer. If the generator contains any liquid, the pressure cannot, of course, be reduced below its vapor pressure. Continued pumping will, however, sweep out the generator with a stream of water vapor. The acid to be introduced (sulfuric, 1 : 8) is contained in and nearly fills the flask *f* which is connected to the generator by a delivery tube as shown. Several pieces of zinc are introduced into the flask, in order to sweep all the air out of the acid and saturate it with hydrogen. When this has been accomplished, the vent *e* is closed until the pressure increases sufficiently in *f*, from the generation of hydrogen, to force the acid through the delivery tube and out the end of the Geissler stopcock; all air is thus removed from the connections. On turning the cock to connect with the generator, the acid will then run into the evacuated generator. Before the acid has reached the level of the zinc, the hydrogen dissolved in it can be removed by pumping in order to further ensure complete absence of air. The proper amount of acid is then allowed to enter and hydrogen generated until it bubbles out through *d*, which shows that the generator is under pressure. The rate of generation is regulated by the cock *c*.

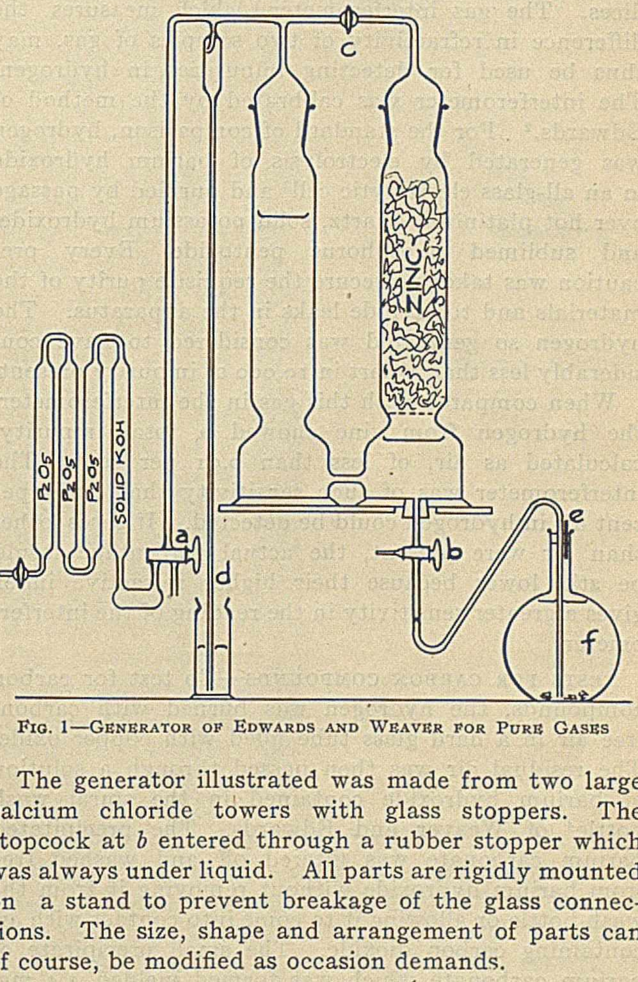

Fig. 1—Generator of Edwards and Weaver for Pure Gases

The generator illustrated was made from two large calcium chloride towers with glass stoppers. The stopcock at *b* entered through a rubber stopper which was always under liquid. All parts are rigidly mounted on a stand to prevent breakage of the glass connections. The size, shape and arrangement of parts can of course, be modified as occasion demands.

PURITY OF HYDROGEN FROM ZINC AND ACID

Although the purity of the gas may vary with the purity of the materials employed, the present tests are of interest as showing the possibilities of the method. The zinc used was a very pure sample from an English source; the acid was J. T. Baker's "C. P." sulfuric acid. The possibility of the hydrogen containing the following impurities should be considered: Oxygen and nitrogen, sulfur dioxide, hydrogen sulfide, acetylene, methane or other hydrocarbons, carbon monoxide, carbon dioxide, arsine, phosphine, stibine, and water vapor.

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[1] Bureau of Standards, *Bulletin* 4 (1908), 345.

Of these impurities, oxygen and nitrogen which might come from air leaks, had to be rigidly excluded because there is no satisfactory method of removing traces of nitrogen. Sulfur dioxide, hydrogen sulfide, and carbon dioxide were removed by passing the gas over solid potassium hydroxide. The gas was thoroughly dried by passing through three tubes of sublimed phosphorus pentoxide. All connections were glass to glass sealed with de Khotinsky cement where necessary. The following tests for impurities were applied to the gas.

REFRACTIVITY—The refractivity of a sample of hydrogen is a delicate criterion of its purity because all gases which are likely to be present have much higher refractive indices than hydrogen; helium and neon are the only gases having lower refractive indices. The gas interferometer,[1] which measures the difference in refractivity of two samples of gas, may thus be used for detecting impurities in hydrogen. The interferometer was calibrated by the method of Edwards.[2] For the standard of comparison, hydrogen was generated by electrolysis of barium hydroxide in an all-glass electrolytic cell[3] and purified by passage over hot platinized quartz, solid potassium hydroxide, and sublimed phosphorus pentoxide. Every precaution was taken to secure the requisite purity of the materials and to exclude leaks in the apparatus. The hydrogen so generated was considered to have considerably less than 1 part in 10,000 of impurity present.

When compared with this gas in the interferometer, the hydrogen from zinc showed a total impurity, calculated as air, of less than 0.01 per cent. The interferometer was of such sensitivity that 0.005 per cent air in hydrogen could be detected. If gases other than air were present, the actual percentage would be still lower because their higher refractive index gives a greater sensitivity in the reading of the interferometer.

TESTS FOR CARBON COMPOUNDS—To test for carbon compounds, the hydrogen was burned with carbon-free air in a hard glass tube filled with copper oxide. The residual air was then passed through a solution of barium hydroxide contained in the spiral wash bottle[4] of Weaver and Edwards. The precipitated barium carbonate was filtered off and washed free from barium hydroxide without removing it from the wash bottle or allowing it to come into contact with air containing carbon dioxide. The small precipitate of barium carbonate which was formed yielded 4.4 mg. of barium sulfate, equivalent to 0.83 mg. of carbon dioxide. If this came from the oxidation of acetylene it would have corresponded to 8 p. p. m. by volume in the 25 l. of hydrogen from which it came.

Acetylene was determined directly in the gas by the colorimetric method of Weaver[5] using an absorbing solution of cuprous chloride containing gelatin, hydroxylamine hydrochloride, alcohol, and ammonia in the proportions recommended in the article cited. The limit of visibility was about 0.02 mg. of acetylene. Only the faintest coloration was secured which indicated not more than 1 or 2 p. p. m. of acetylene. The remainder of the carbon found in the previous test may have come from traces of carbon monoxide, methane, or other hydrocarbons.

Hydrogen generated from a sample of hydrone contained 4 p. p. m. of acetylene as determined in the same manner.

TESTS FOR ARSINE AND STIBINE—Arsine and stibine were absent as indicated by the lack of any deposit on the passage of the gas through a heated tube. Arsenic and antimony were not detected in the chemical analysis of the zinc.

All of these results confirm the conclusions arrived at from the indications of the interferometer, namely, that hydrogen containing not more than 1 part in 10,000 of impurity can be prepared from zinc with the generator described.

It was of interest to determine the purity of gas obtained from an ordinary Kipp. The gas was compared with the hydrogen from the generator shown in Fig. 1, by means of the interferometer. The gas from the Kipp was purified by passage through soda lime and anhydrous, granular calcium chloride. There was a short piece of rubber tubing leading to the drying tower and three rubber stoppers in the line. No leaks were detected in the system upon evacuation. The purity of the hydrogen and the amount generated by the Kipp were determined every 5 min. The results are shown in Table I.

TABLE I—COMPARISON OF PURITY AND YIELD OF HYDROGEN FROM KIPP GENERATOR

Time from Start of Generation Min.	Purity of Hydrogen Per cent	Total Volume of Gas Generated Liters	Calculated Volume of Gas Required to Reach Indicated Purity Liters
17	83.86	3.96	4.00
22	93.59	6.02	6.03
27	97.86	8.50	8.45
32	99.51	11.58	11.70
37	99.92	15.00	15.69
42	99.97	18.35	17.84
57	99.974	28.4	18.17
77	99.973	41.7	...
112	99.976	74.3	18.3

The results given in Column 4 of the table were calculated from the following equation:[1]

$$\frac{\text{Total Gas Evolved}}{\text{Total Gas Space}} = \log_e\left(\frac{1}{1-\dfrac{a}{100}}\right)$$

In this equation a is the purity of the hydrogen expressed as a percentage. The gas space in the case of the generator tested was 2.2 l. It is assumed in this equation that there is perfect mixing at all times of the hydrogen with the air in the generator. The agreement between the experimental and the calculated values is quite satisfactory and shows that the equation can be used in calculating the sweeping-out period for any similar generator when gas of any required purity is desired.

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[1] For a description of the gas interferometer, see L. H. Adams, *J. Am. Chem. Soc.*, **37** (1915), 1181.

[2] *Ibid.*, **39** (1917), 2382.

[3] Similar in design to that of Weber, Bureau of Standards, *Bulletin* **9** (1913), 135.

[4] THIS JOURNAL, **7** (1915), 534.

[5] *J. Am. Chem. Soc.*, **38** (1916), 352.

[1] Weaver, "Generation of Hydrogen from Ferrosilicon," 4th Annual Report Nat. Adv. Comm. for Aëronautics, 1918.

Hydrogen of approximately the same purity (99.97 per cent hydrogen) was prepared in the same Kipp from J. T. Baker's "C. P." zinc said to contain a trace of arsenic and antimony.

SUMMARY

A generator is described with which hydrogen containing not more than 1 part in 10,000 of impurities can be prepared from zinc and acid. Methods of testing for contaminating gases are described. The relation between the volume of gas generated and purity of the product is given by an equation which was verified experimentally.

Bureau of Standards
Washington, D. C.

AN APPARATUS FOR RAPID GASTRIC ANALYSIS TOGETHER WITH A METHOD FOR THE PRESERVATION OF STARCH SOLUTION

By Raymond J. Miller

Received November 29, 1918

Considerable of the success accomplished along the line of gastric investigation conducted at the Jefferson Medical College recently is due to an apparatus designed by one of the members of the research staff, the author of this contribution. With the aid of this apparatus the manipulation of different solutions used in the several analyses has been shortened. The apparatus demonstrates its real value not in the handling of one case for analysis but rather when three or more are to be run.

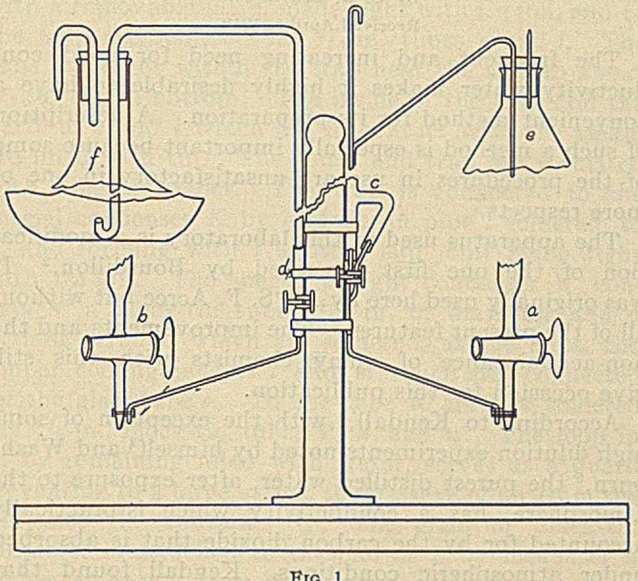

Fig. 1

a—Alkali Burette
b—Thiosulfate Burette
c—Automatic Pipette
d—Syphon Device (Starch)
e—Formation Reservoir
f—Starch Solution

In gastric analysis as conducted in this laboratory the following determinations are considered of most importance:

1—Total Acidity: Titration with *N*/100 potassium hydroxide.

2—Free Acidity (Sahli Method): Titration with *N*/100 sodium thiosulfate, finishing with starch solution.

3—Formol Titration or Amino Acid Nitrogen Complex: Addition of neutral formalin and titrating with *N*/100 potassium hydroxide.

The apparatus is designed to meet the requirements for these three determinations.

APPARATUS

To set up the apparatus the following material is necessary:

1—Double burette stand.

2—Two certified burettes, 30 cc. capacity, graduated to 0.05 cc.

3—Capillary glass tubing, 1 to 2 mm. inner diameter.

4—Four glass T tubes: Three, inner diameter 3 mm. One, inner diameter 4 mm.

5—Red rubber tubing, inner diameters of 1 to 2 mm. and also 4 mm.

6—Pinchcocks, three plain and one special two-way cock.

7—Adhesive tape.

Fig. 1 shows the apparatus as completed and in running order in the laboratory. The burette on the right is connected to the alkali reservoir, that on the left to the thiosulfate. At the top of the burettes is placed an arrangement which is shown in detail in Fig. 2. Near the base of the burette stand two devices will be observed. The one on the right leading to the tip of the alkali burette is an automatic pipette used in the formol titration, and is shown in detail in Fig. 3. The attachment on the left leading to the tip of the thiosulfate burette is an ordinary gravity device for the rapid addition of starch solution.

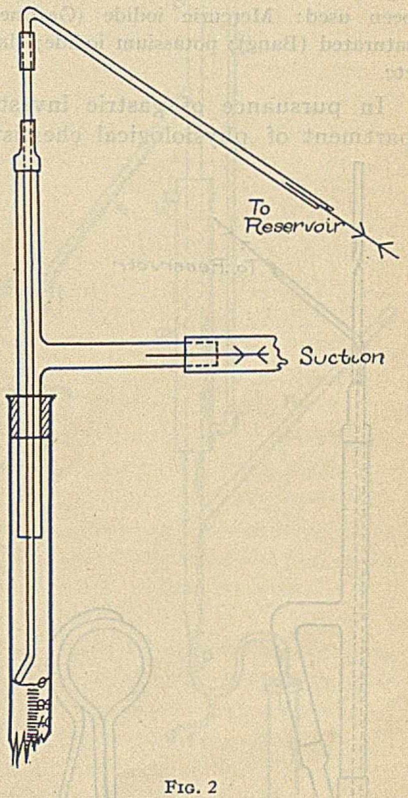

Fig. 2

Fig. 2 illustrates the overhead arrangement whereby the burette can be filled by suction and when the same is released any excess solution drawn over is immediately withdrawn back into the reservoir, leaving the burette reading 0.00 cc.

Fig. 3 shows the automatic pipette which, as soon as its charge is delivered, automatically fills up to approximately its former level and is again ready to be discharged. The principle upon which this device depends is a two-way pinchcock as illustrated at A, Fig. 3. This type pinchcock was designed by another author and reported some time since.

Very little has been said in regard to the assembling of material for the several devices as it has been taken for granted that the figures are self-explanatory. Perhaps but one thing needs an explanation and that is the purpose of the adhesive tape. It will be observed in Fig. 1 that the automatic pipette *c* and the starch dropping device *d* are attached directly to the upright support of the burette stand. Adhesive tape was found to be the best means of fastening these devices to the support.

STARCH SOLUTION

The delicacy of starch solution as an indicator for iodimetric and thiosulfate titrations is well known. Its rapid deterioration, mainly due to the presence of molds, has thus far required the observation of the following precautions in its preparation:

1—That the starch solution be made up fresh each day.

2—That the cold starch solution be placed in small bottles, sterilized for 2 hrs. on a water bath at 100°, closing with soft sterilized stoppers and keeping the individual bottles to be opened as the occasion required (Stokes).

3—That preservatives be added. Of these the following have been used: Mercuric iodide (Gastine); potassium chloride, saturated (Bang); potassium iodide; zinc chloride; chloroform; etc.

In pursuance of gastric investigations in the department of physiological chemistry of the Jefferson Medical College, the problem of preparing a starch solution which would remain intact over a considerable period of time with as little addition of foreign material as possible was studied by the author. As a result the following procedure was developed for use in the laboratory in connection with the determination of free acidity of gastric juice by the Sahli method.

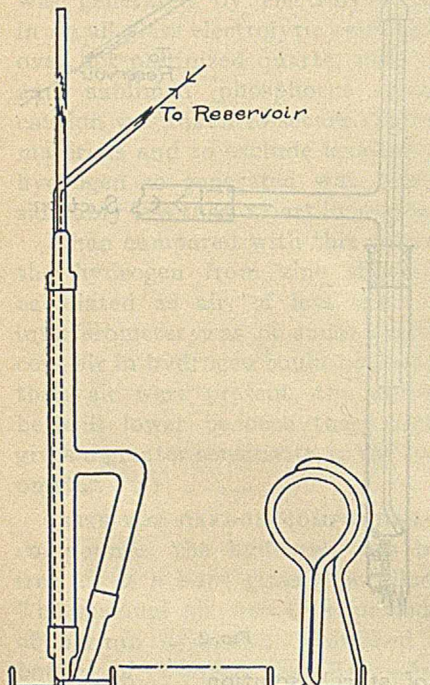

FIG. 3

Rub up in a mortar, with sufficient cold distilled water to form a paste, 10 g. of soluble starch (Lintner). Boil 2 l. of distilled water for 15 min. To approximately 750 cc. of the boiling water add the starch paste and stir thoroughly. Continue heating for 10 min. Place the hot solution in a clean graduated cylinder and make up to a liter with the remainder of the boiling water.

Rinse the flask to be used as a reservoir with scalding water as well as the siphon device (see Fig. 1).

Immediately place the hot starch solution in the reservoir, 1 cc. of toluol may or may not be added. If it is added, it is well to shake or stir the solution throughout. Immediately float a layer of liquid petrolatum, $^1/_4$ in. deep, over the surface of the hot solution. Place the short leg of the siphon device in position within the reservoir. Carefully charge the siphon with the pinchcock open. When so charged the siphon is in running order until the reservoir becomes practically "dry."

The addition of toluol to the solution, it is believed, can readily be omitted and is added only to ensure a preservation of the solution in the siphon during the first usage of the starch solution.

In Fig. 1 it will be noticed that the end of the short leg of the siphon is bent upward. The object of this is to avoid disturbance of the layer of residual dextrin (Blake) which generally sediments at the end of 24 hrs. standing.

This starch solution used in this apparatus has been found to give no trace of reddish coloration with iodine for a period of 6 mos. A further study of the solution was rendered impossible because of the exhaustion of the reservoir supply. Aside from the saving of valuable time by using the above procedure, the fact that starch solution having practically the same properties as a freshly prepared one with little or no addition of foreign material, was always at hand, was of great importance.

JEFFERSON MEDICAL COLLEGE
PHILADELPHIA, PA.

RAPID AND CONVENIENT METHOD FOR THE PREPARATION OF CONDUCTIVITY WATER[1]

By C. B. CLEVENGER

Received April 5, 1919

The frequent and increasing need for good conductivity water makes it highly desirable to have a convenient method for its preparation. A description of such a method is especially important because some of the procedures in use are unsatisfactory in one or more respects.

The apparatus used in this laboratory is a modification of the one first described by Bourdillon.[2] It was originally used here by Dr. S. F. Acree but without all of the present features. The improvements and the non-acquaintance of many chemists with this still give occasion for this publication.

According to Kendall,[3] with the exception of some high dilution experiments noted by himself[4] and Washburn,[5] the purest distilled water, after exposure to the atmosphere, has a conductivity which is practically accounted for by the carbon dioxide that is absorbed under atmospheric conditions. Kendall found that the conductivity values of water in equilibrium with the air ranged from 0.75×10^{-6} to 0.90×10^{-6} reciprocal ohms at 25° C. It is, therefore, futile to prepare and use water having lower values than the above unless it is carefully protected from the carbon dioxide of the air at all times. It is only for conductivity measurements of the greatest precision that

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[1] Published by permission of the Director of the Wisconsin Agricultural Experiment Station.

[2] *Trans. J. Chem. Soc.*, **103** (1913), 791.

[3] *J. Am. Chem. Soc.*, **38** (1916), 1480, 2460.

[4] *Ibid.*, **39** (1917), 7.

[5] *Ibid.*, **40** (1918), 106.

this protection is advisable and necessary. For measurements of this kind the water produced by the method here described may be redistilled and appropriately protected.

PRINCIPLE OF THE BOURDILLON STILL

The basic principle on which the Bourdillon still[1] operates and in which it is different from others is that the water is purified largely while in the vapor condition by means of a current of pure air. This is accomplished as follows: Steam, from water to which phosphoric acid or potassium acid sulfate is added, first passes through a trap where substances less volatile than steam are condensed and eliminated. The steam then passes up into a specially constructed condenser through which a rapid stream of purified air is forced. This stream of air, moving through the steam, sweeps out the impurities.

DETAILS OF CONSTRUCTION

The accompanying figure shows the construction of the modified still. Its main parts are a copper boiler, A, a copper trap, F, and a special condenser, K, in which the purification and condensation of the steam take place. The boiler A of about 15 l. capacity is fitted with a glass gauge and a screw cap, *b*, for filling. It is connected to the trap F by the block-tin spiral D. The spiral is joined to the boiler by means of the metal collar *c* and to the trap F by means of the slip joint *e* made tight with tin foil. This spiral stops spray and condenses the less volatile substances which pass off through the outlet *h*. The cylindrical trap is provided with a removable lid, *g*, made tight with tin foil, and to the trap are soldered the $^3/_4$-in. tubes *e* and *i*. The tube *e* extends within the trap near the side to about $^1/_2$ in. of the bottom. The inside of the trap and the parts of *e* and *i* which are in contact with the steam are lined with tin. The spiral and trap are insulated with asbestos paper. The trap is connected to the special condenser K by a block-tin pipe *t* soldered to K and forming with *i* another slip joint made tight with tin foil. The special upright condenser K consists of a block-tin tube $1^1/_4$ in. in diameter and 6 ft. long, around which are soldered, at the ends, the copper cooling jackets *l* and *m* which are connected by the glass tube *o*. To the tube K are also soldered the $^5/_8$-in., block-tin tubes P, *n*, and *w*. The loop in P, by remaining filled with water, serves as a guard preventing to a large extent the passage of air from the still into the container Q. The glass or block-tin container is attached to the end of P by means of a rubber stopper. It is fitted with a siphon or water cock and a guard tube of soda lime. To P is soldered an independent outlet *r* consisting of a $^1/_2$-in. block-tin tube, the end of which is provided with a solid block-tin stopper. This outlet furnishes a convenient means for obtaining small portions of water to be tested and for discarding the first of the distillate. The measurements of all tubes are outside diameters.

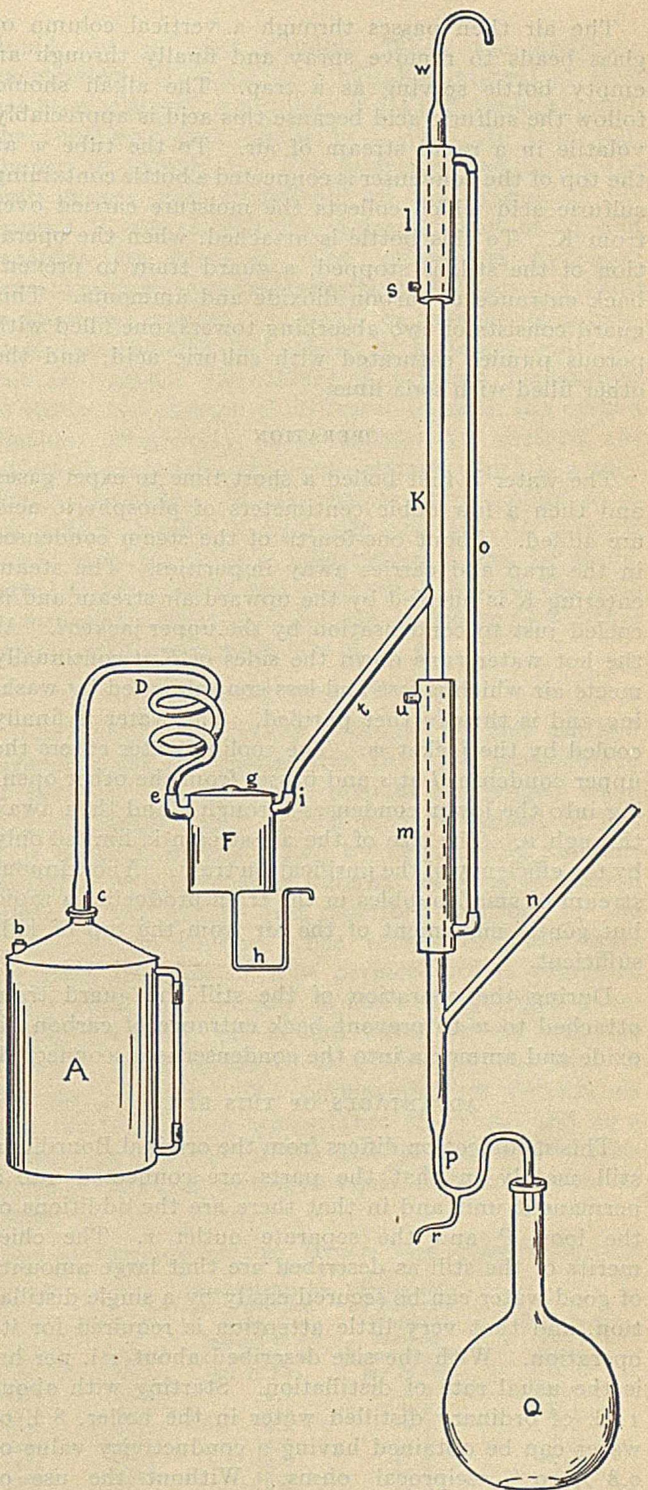

Fig. 1

Connected to *n* but not shown in the figure is a train for the purification of the air stream which is preferably produced by means of an electrically driven rotary pump. An ordinary water filter pump arranged for producing pressure may be used, but this requires more attention and often does not give uniform pressure which is essential. Air may also be drawn through by suction, but this results in the danger of impure air coming through the joints. The air stream is purified by passing through 2 l. bottles, filled two-thirds full of concentrated sulfuric acid and broken glass, and then through two similar bottles containing a solution of concentrated sodium hydroxide. An empty bottle should be placed between the acid and alkali.

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[1] *Loc. cit.*

The air then passes through a vertical column of glass beads to remove spray and finally through an empty bottle serving as a trap. The alkali should follow the sulfuric acid because this acid is appreciably volatile in a rapid stream of air. To the tube *w* at the top of the condenser is connected a bottle containing sulfuric acid which collects the moisture carried over from K. To this bottle is attached, when the operation of the still is stopped, a guard train to prevent back entrance of carbon dioxide and ammonia. This guard consists of two absorbing towers, one filled with porous pumice saturated with sulfuric acid, and the other filled with soda lime.

OPERATION

The water is first boiled a short time to expel gases and then a few cubic centimeters of phosphoric acid are added. About one-fourth of the steam condenses in the trap and carries away impurities. The steam entering K is purified by the upward air stream and is cooled just to condensation by the upper jacket *l*. As the hot water runs down the sides of K it continually meets air which is less and less contaminated by washing and is thus further purified. The water is finally cooled by the jacket *m*. The cooling water enters the upper condenser *l* at *s* and passes from the other opening into the lower condenser through *o* and then away through *u*. The size of the air stream is limited only by the efficiency of the purification train. A continuous stream of small bubbles in the train producing a rapid but gentle movement of the air from the top of K is sufficient.

During the operation of the still the guard train attached to *w* to prevent back entrance of carbon dioxide and ammonia into the condenser is disconnected.

ADVANTAGES OF THIS STILL

This modification differs from the original Bourdillon still mainly in that the parts are connected into a permanent unit and in that there are the additions of the loop P and the separate outlet *r*. The chief merits of the still as described are that large amounts of good water can be secured easily by a single distillation, and that very little attention is required for its operation. With the size described about 1 l. per hr. is the usual rate of distillation. Starting with about 12 l. of ordinary distilled water in the boiler, 8 l. of water can be obtained having a conductivity value of 0.8×10^{-6} reciprocal ohms. Without the use of phosphoric acid or any chemicals in the boiler a value of about 1.0×10^{-6} is secured. These values are of the water after exposure to the air and the former agrees well with the average value of those reported by Kendall.

Should small quantities of water of a better quality be desired these may be obtained directly from the still through *r* during the middle of a distillation period. Where there is need for considerable conductivity water of good quality this type of still has many advantages.

Departments of Soil and Agricultural Bacteriology
Agricultural Experiment Station
University of Wisconsin, Madison, Wisconsin

A METHOD FOR DETERMINING THE PERMEABILITY OF BALLOON FABRICS

By Junius David Edwards and S. F. Pickering

Received March 25, 1919

The rapid development of lighter-than-air craft in the past few years has stimulated the development of fabrics which are relatively impervious to gases, especially to hydrogen. Concurrent with the development of fabrics has been the development of apparatus and methods for determining their permeability to gases. The Bureau of Standards has already given[1] a description of the methods commonly used for determining permeability together with the results of an investigation of the effect of experimental conditions upon the real and apparent permeability.

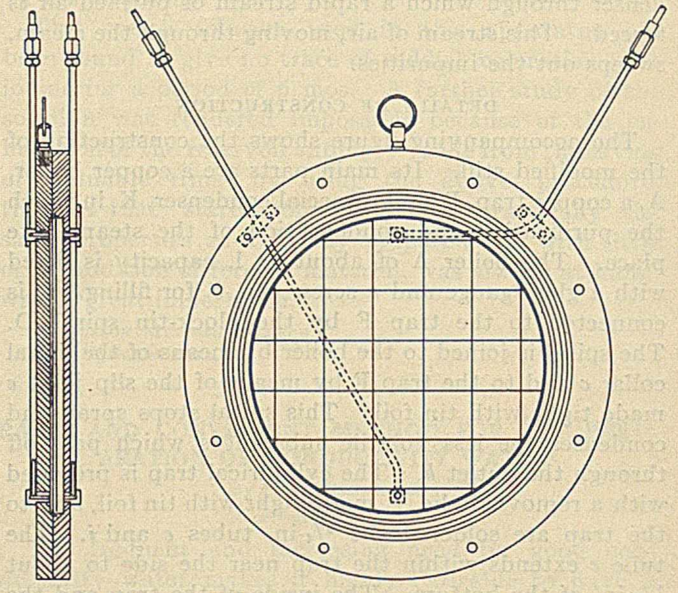

Fig. 1—Cell for Holding Fabric for Permeability Test

The method adopted by the Bureau for most of its work may be briefly described as follows: The fabric which is to be tested is firmly held between the two halves of a circular metal cell (Fig. 1) which is divided thereby into two chambers. A current of pure, dry hydrogen is passed through one chamber so that one surface of the fabric is maintained in an atmosphere of hydrogen under a pressure of 30 mm. of water above the pressure on the opposite side. A current of dry air is passed through the other chamber and the hydrogen which penetrates the fabric diffuses into the air. The resultant mixture of air and hydrogen is passed through a gas interferometer, where the percentage of hydrogen is determined, and through a precision gas meter which measures the rate of air flow. From these factors and the area of fabric exposed, the permeability is calculated. This method is precise and rapid but requires a gas interferometer, which is an expensive instrument and one not readily available at the present time. An alternative method which is extensively used is to determine the amount of hydrogen by combustion, with subsequent weighing as water after absorption in some suitable medium. This procedure, however, is tedious and time-consuming, and leaves much to be desired in many respects.

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[1] J. D. Edwards, "Determination of Permeability of Balloon Fabrics," Bureau of Standards, *Technologic Paper* **113**, 1919.

DESCRIPTION OF NEW METHOD

We have devised another method based upon a different system of operation which permits the volumetric determination of the hydrogen and which dispenses with both the interferometer and gas meter. While it has not superseded at the Bureau the standard method just described, it offers certain advantages which make it of interest and value to other experimenters in this field.

The novel feature of the method lies in the use of carbon dioxide instead of air for sweeping the hydrogen out of the cell. The mixture of carbon dioxide and hydrogen is then passed into a bulb containing a solution of sodium hydroxide; this solution absorbs the carbon dioxide and leaves as a residue the hydrogen which diffused through the fabric, together with traces of air originally present in the carbon dioxide.

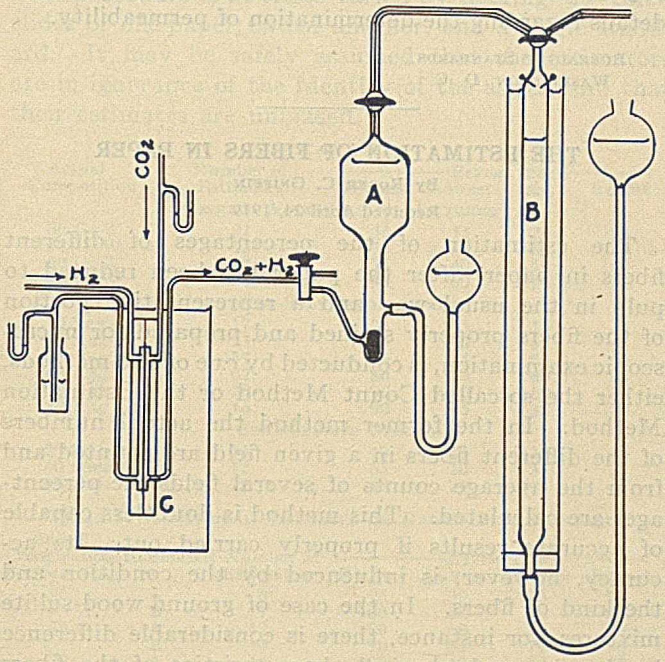

FIG. 2—DIAGRAM OF PERMEABILITY APPARATUS

A diagram (not drawn to scale) of the apparatus as used is shown in Fig. 2. The fabric is held in the cell C which is suspended in a constant temperature bath maintained at a temperature of 25° C.[1] The stream of hydrogen passes out through a water seal which maintains an excess pressure equivalent to 30 mm. of water in the cell. The carbon dioxide and hydrogen from the other chamber pass into the base of the absorption bulb A through a small mercury seal as indicated. The height of the leveling bulb is adjusted so that the gas enters in a steady stream at the proper pressure. This latter condition also requires careful adjustment of the depth of the mercury seal. The bulb A is made wide so that the levels of the liquid will change as little as possible, thus making frequent adjustment of the leveling bulb unnecessary. For this reason it is also desirable to start the test with a small volume of air in the more constricted upper part of the bulb where the volume of the apparatus and consequently the level of the liquid change most rapidly. When the hydrogen penetrating the fabric in a suitable interval of time has been collected, the stream of gas is diverted through the three-way cock either to a duplicate bulb (not shown) or to the air. The hydrogen and air in the bulb A are then transferred to the graduated gas burette B, mixed with the proper amount of air and exploded by sparking. The volume of hydrogen present is then calculated from the contraction in volume in the usual manner. It would be possible, of course, to measure directly the volume of hydrogen collected, but it requires the taking of extreme precautions to ensure the absence of all traces of air in the carbon dioxide. Practically, it is simpler to analyze the collected gas by the explosion method, which is a very simple procedure. It also removes any doubts as to the actual volume of hydrogen present. In running check tests the sample collected in A can be transferred to the burette and analyzed at leisure, the bulb A meanwhile being used for the collection of another sample with a minimum loss of time.

RESULTS OF TESTS

The validity of results obtained by this method depends upon the assumption that the permeability of the fabric to hydrogen remains unchanged when it is in contact with carbon dioxide instead of air. This assumption was tested by determining the permeability of a number of different samples of balloon fabric by the method just described and also by the interferometer method. The results of these tests are given in Table I. The permeability is expressed in the customary manner as liters of hydrogen penetrating the fabric per square meter per 24 hrs., the hydrogen being measured at 0° C. and 760 mm. of mercury pressure. The permeability is determined with the fabric at a temperature of 25° C. and at a pressure on one side of 760 mm. of mercury with an excess pressure of hydrogen equivalent to 30 mm. of water.

TABLE I—COMPARISON OF NEW METHOD WITH BUREAU'S STANDARD METHOD

Test No.	Fabric No.	Permeability by New Method Using CO_2 Instead of Air L. per Sq. M. per 24 Hrs.	Permeability by Bureau's Standard Method L. per Sq. M. per 24 Hrs.	*Difference* (Col. 3 Minus Col. 4)
1412	24579	6.7	6.7	0.0
1416	36827	9.5	8.8	+0.7
1454	36827	9.8	9.8	0.0
1467	36827	11.1	11.1	0.0
1474	26293	12.0	11.8	+0.2
1504	26293	13.0	13.2	—0.2
1535	24674	17.2	17.5	—0.3
1541	24674	15.5	15.5	0.0
			AVERAGE DIFFERENCE....	0.18

The agreement of the results obtained by the two methods is very satisfactory. The effect of carbon dioxide upon the permeability to hydrogen was also tested by running a sample by the standard method, using carbon dioxide in place of air and determining the hydrogen with the interferometer; carbon dioxide of the same purity was used as a comparison gas in the interferometer. These latter data are relatively few in number but corroborate our conclusion that within the limit of experimental error the carbon dioxide does not influence the permeability to hydrogen.

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[1] For data on the large variation of permeability with temperature see *Technologic Paper* 113, 12.

EDGE EFFECT IN TESTING BALLOON FABRICS

It may be well to call attention again to a source of error[1] common to all permeability methods and which has not, perhaps, been sufficiently emphasized. This error is due to imperfect delimitation of the area of fabric under test. The great majority of fabrics in use contain at least two plies of cloth with a layer of rubber in between and usually a thinner layer of rubber on one or both sides. The rubber seldom penetrates the interstices between the threads very thoroughly and, as a result, hydrogen is able to diffuse laterally along the textile as well as directly through the rubber film. Under these circumstances hydrogen which has diffused through the textile can pass through the main layer of rubber, where it is clamped between the edges of the cell, and back through the textile on the other side into the air chamber. The exposed or "active" area of fabric is then larger than the area defined by the edges of the cell and the results are correspondingly high. If there is no rubber on either side or on only one side, the fabric can be satisfactorily sealed with vaseline or soft wax applied hot, which fills up the space between the threads and prevents lateral diffusion of the hydrogen. However, if the fabric is rubber-coated on both sides, which is the general practice in this country for envelope fabrics, the vaseline cannot penetrate the rubber coating into the cloth underneath; no satisfactory method of sealing such fabrics is known. The best procedure is to reduce the margin of the fabric to as small an area as possible and put hot wax on the edge. The possible error if the whole margin is active can be easily calculated. The Bureau's practice is to run such fabrics with a margin not over 4 mm. in width in a cell having an area of 250 sq. cm. The error can then not be over 9 per cent, or 1 liter on an "11 liter" fabric, and this correction can be applied if desired.

NOTES ON NEW METHOD

Aside from the simplicity and availability of the necessary apparatus, the new method possesses a number of advantages which may be pointed out. The permeability over the whole testing interval is averaged; this tends towards uniformity of results. The permeability may be estimated roughly during the course of a test by observing the rate at which the gas collects in A. This is of value with a fabric having a high permeability. The method eliminates the danger from explosions which frequently occur with the combustion method when a fabric of high permeability is tested. If two or three cells are being used only one gas burette need be employed since it can be connected to the absorption bulbs in turn.

With a fabric having a permeability of 10 l. per sq. m. per 24 hrs., about 5.5 cc. of hydrogen are collected in 30 min. with a cell having an area of 250 sq. cm. This gives a contraction of 8.2 cc. upon explosion. A gas burette graduated to 0.1 cc. thus enables the hydrogen to be determined with an accuracy of about 0.1 l. under the assumed conditions. This is ample accuracy for most purposes. It is rather difficult to manufacture a roll of balloon fabric which will not show differences of 0.5 to 1.0 l. from place to place in the roll. Differences of 2 and 3 liters are not unusual in the ordinary run of fabric.

SUMMARY

We have described a method of determining the permeability of balloon fabrics to hydrogen in which the hydrogen penetrating a given area of fabric is collected in a stream of carbon dioxide. The carbon dioxide is absorbed in alkali as in a nitrometer; the hydrogen remaining is then determined volumetrically by explosion with air in a gas burette. Simplicity and availability of apparatus combined with a satisfactory precision of results make the method of value to experimenters not desiring to install a more elaborate set-up. The reader is referred to *Technologic Paper* 113 of the Bureau of Standards for supplementary details regarding the determination of permeability.

Bureau of Standards
Washington, D. C.

THE ESTIMATION OF FIBERS IN PAPER

By Roger C. Griffin

Received April 24, 1919

The estimation of the percentages of different fibers in paper, after the paper has been reduced to pulp in the usual way and a representative portion of the fibers properly stained and prepared for microscopic examination, is conducted by one of two methods, either the so-called Count Method or the Estimation Method. In the former method the actual numbers of the different fibers in a given field are counted and from the average counts of several fields the percentages are calculated. This method is doubtless capable of accurate results if properly carried out. Its accuracy, however, is influenced by the condition and the kind of fibers. In the case of ground wood-sulfite mixtures, for instance, there is considerable difference in the size and physical characteristics of the fibers and they cannot all be given equal weight in counting. The same is true of paper where the pulp has been much beaten.

By the estimation method the observer visualizes the field as a whole under the microscope and estimates the proportions of the field occupied by the different kinds of fibers, in his final report, of course, averaging his estimates of several fields. It is hardly necessary to say that the observer should train his eye by examining slides made up from papers of known fiber composition, and that such slides should be frequently examined in comparison with the papers whose fiber composition is to be ascertained.

The Committee on Paper Testing of the Technical Association of the Pulp and Paper Industry in its 1917 report[1] recommends the estimation method, believing it to have the following advantages: "(1) It is more accurate under certain conditions, namely, in making ground wood determinations, and of equal accuracy under all other conditions; (2) it is much quicker; (3) it is easier to teach an individual to estimate

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[1] Edwards, *Aviation and Aëron. Eng.*, 4 (1918), 104.

[1] *Paper*, October 17 and 24, 1917.

correctly than to count correctly; (4) it is possible to make up standard mixtures for ready comparison."

The estimation method of fiber analysis has been used in this laboratory for many years with satisfactory results. The well-known Herzberg zinc chloride-iodine stain is used for staining the fibers. Two slides of each paper sample are prepared and they are marked with key numbers so that the individual analysts do not know which slides are duplicates. Frequent standard slides are included with the unknowns and these are also marked with numbers only. The estimates of each individual are turned in to the chief analyst who tabulates and averages them. In comparatively rare instances, where the agreement between different estimators is not satisfactory, two more slides are made up and given different numbers, and often a different standard is included with them. This procedure is at times varied by making up three slides of one paper, two of another, and a single standard. It may be safely assumed that the estimators are in ignorance of the identity of the slides, and that their estimates are unbiased.

TABLE I

Actual Composition	Number of Estimates	ESTIMATES Highest	Lowest	Av.	Report
		GROUND WOOD-SULFITE MIXTURES			
30 G. W.	21	35	15	26	25
50 G. W.	13	70	40	50	50
60 G. W.	42	75	40	59	60
80 G. W.	24	95	60	76.5	75
		RAG-SULFITE MIXTURES			
10 Rag	17	25	5	13	15
40 Rag	23	60	30	43	45
60 Rag	59	75	45	63	65
65 Rag	62	80	40	66.5	65
70 Rag	50	90	50	69	70
80 Rag	16	90	75	83	85
		SODA-SULFITE MIXTURES			
30 Soda	13	40	15	30	30
40 Soda	42	65	10	35	35
50 Soda	22	65	25	44	45

TABLE II—INDIVIDUAL ESTIMATES ON RAG-SULFITE STANDARDS

Actual Composition Per cent Rag	Estimated by	Number of Estimates	ESTIMATES Highest	Lowest	Average	Report
90	A	8	95	90	93	95
	B	7	100	95	96	95
80	A	12	90	60	81	80
	B	13	90	55	79	80
70	A	15	90	60	72	70
	B	17	75	50	68	70
65	A	13	80	50	67	65
	B	15	75	50	66	65
60	A	14	85	45	64.5	65
	B	13	75	50	66.5	65
40[1]	A	13	75	35	48	50
	B	12	65	40	55	55
30	A	12	40	25	32	30
	B	7	50	25	37	35
10	A	3	20	5	10	10
	B	3	15	5	10	10

RECAPITULATION

	Chemist A	Chemist B
Total estimates	90	87
Correct	24 = 27%	20 = 23%
Within 5 per cent	57 = 63%	51 = 59%
Within 10 per cent	76 = 84%	72 = 83%
More than 10 per cent variation	14 = 16%	15 = 17%
OMITTING THE 40 PER CENT STANDARD		
Total estimates	77	75
Correct	21 = 27%	19 = 25%
Within 5 per cent	51 = 66%	50 = 67%
Within 10 per cent	66 = 84%	67 = 89%
More than 10 per cent variation	11 = 16%	8 = 11%

[1] The original 40 Rag-60 Sulfite standard was not properly made up. When this was discovered a new standard was prepared. The results in Tables I and III are on the new standard but in Table II results are on both standards as it was impossible to separate the figures.

The standard papers were very carefully prepared in this laboratory from pure stock, making correction for moisture content.

TABLE III

Per cent Ground Wood	Individuals	Highest	Lowest	Av.	Report	Deviation
		GROUND WOOD-SULFITE MIXTURES				
30	6	35	20	26	25	— 5
	6	30	15	21	20	—10
	5	30	20	26	25	— 5
40	5	50	30	36	35	— 5
50	8	70	40	52	50	0
	5	50	40	47	45	— 5
60	7	70	50	59	60	0
	5	60	50	52	50	—10
	6	75	50	65	65	+ 5
	6	75	50	64	65	+ 5
	5	70	55	61	60	0
80	8	80	60	67	65	—15
	5	85	70	76	75	— 5
	6	95	80	90	90	+10
	5	75	70	73	75	— 5
		MANILA-SULFITE MIXTURES				
Per cent Manila						
30	5	55	15	36	35	+ 5
40	7	50	35	45	45	+ 5
50	7	55	40	49	50	0
	7	65	30	51	50	0
		RAG-SODA MIXTURE				
Per cent Rag						
70	7	85	65	74	75	+ 5
		RAG-SULFITE MIXTURES				
Per cent Rag						
10	6	10	5	8	10	0
	5	20	10	14	15	+ 5
	6	25	10	16	15	+ 5
20	7	25	15	21	20	0
30	7	50	35	43	45	+15
	8	45	25	34	35	+ 5
	7	60	35	44	45	+15
	7	50	35	41	40	+10
40	8	65	35	49	50	+10
	6	45	35	39	40	0
	5	60	30	43	45	+ 5
60	6	70	45	54	55	— 5
	6	65	50	59	60	0
	5	70	60	65	65	+ 5
	6	70	60	67	65	+ 5
	5	65	50	59	60	0
	7	70	60	67	65	+ 5
	5	75	60	66	65	+ 5
	8	70	60	62	60	0
	5	75	60	66	65	+ 5
	6	75	50	67	65	+ 5
65	6	80	60	69	70	+ 5
	5	80	70	73	75	+10
	6	70	55	64	65	0
	6	80	65	69	70	+ 5
		RAG-SULFITE MIXTURES				
Per cent Rag						
65	10	75	50	65	65	0
	10	70	50	62	60	— 5
	7	70	70	70	70	+ 5
	8	70	60	61	60	— 5
70	6	80	65	72	70	0
	7	75	50	64	65	— 5
	10	80	60	70	70	0
	5	90	50	70	70	0
	7	80	60	74	75	+ 5
	7	85	65	74	75	+ 5
80	6	90	80	85	85	+ 5
	5	90	75	83	85	+ 5
	5	85	75	80	80	0
		SODA-SULFITE MIXTURES				
Per-cent Soda						
10	6	20	15	19	20	+10
30	5	40	15	32	30	0
	8	35	15	28	30	0
40	9	55	10	30	30	—10
	7	65	20	38	40	0
	8	60	30	45	45	+ 5
	6	45	10	30	30	—10
	5	45	20	33	35	— 5
	7	50	30	34	35	— 5
50	9	65	40	51	50	0
	7	50	25	36	35	—15
	6	50	35	46	45	— 5
60	6	50	30	44	45	—15
70	7	75	65	68	70	0
90	8	100	85	95	95	+ 5
	5	95	90	92	90	0
95	8	100	80	96	95	0

A record has been kept for some time of the individual estimates on certain of the standard slides and sufficient data has been accumulated to give some idea of the degree of accuracy that may be expected. It is our custom to report fiber estimations to the nearest even 5 per cent. In Table I is given a résumé of the results on those standards which have been most in use. All figures except the second column are percentages.

The maximum and minimum figures vary in some cases considerably from the true composition. We have made no attempt, however, to cut out the poor ones, but have taken them just as they come. In many cases the highest and lowest figures are accounted for by new and inexperienced estimators. In making reports on unknown papers this is, of course, taken into consideration. Notwithstanding the individual variations, the averages are satisfactory.

In Table II we have arranged the estimates of two individual chemists, A and B, on the rag-sulfite series. Each estimate was made on a different slide and on different days. They extend over a period of about five years.

These figures would indicate that only about one estimate out of 6 or 8 made by an individual on rag-sulfite mixtures is more than 10 per cent from the true composition and where from 5 to 10 people estimate on a single slide it may be expected that the average will be within 5 per cent of the actual composition. In rare cases there may be a variation of 10 per cent, but this should not be exceeded if five or more individuals make independent estimations which are within reasonable accord and if their estimates are frequently checked up by standard slides. Ground wood-sulfite and soda-sulfite mixtures are more difficult and in rare cases there may be 15 per cent variation but ordinarily the results may be expected to be within 5 or 10 per cent of the actual composition.

Table III shows that the above statements are borne out by results in this laboratory on standard slides. In this table are given the actual results, taken just as they come, on various standards where five or more individuals have estimated on them at one time.

It is to be remembered that the above figures are all on single slides. On unknown papers where duplicate slides are employed probably still greater accuracy may be expected.

SUMMARY

The estimation method of fiber analysis as applied to papers has been thoroughly tested out and has given satisfactory results in this laboratory for considerably more than 15 years. When carried out as above described it may be expected to give results accurate to within 5 per cent or better on rag-sulfite mixtures and within about 10 per cent or better on ground wood-sulfite and soda-sulfite mixtures.

Laboratory of Arthur D. Little, Inc.
Cambridge, Massachusetts

DATA OF INTEREST IN THE BARIUM INDUSTRY

By Louis S. Potsdamer

Received February 19, 1919

Since September 1914, when the barium industry in the United States sprang into being, there has been a tremendous growth. Starting with one firm at that time, at least two dozen are active now and rapidly growing. Of course, some have fallen by the wayside, but they represent a very small minority.

Very little data of use in this industry have been published and we therefore offer the tables attached, for what they may be worth.

Table I was compiled by the writer in collaboration with Alexander Strobl, and it has recently been corrected. It gives at a glance equivalents of chemicals frequently used in this industry.

Table I

$BaSO_4$	1.18	1.12	0.96	3.19	0.81	1.00
BaS	0.86	0.82	0.70	2.32	0.59	0.73
$BaCO_3$	1.00	0.95	0.81	2.70	0.69	0.85
BaO_2	0.86	0.82	0.70	2.32	0.59	0.73
BaO	0.78	0.74	0.63	2.10	0.54	0.66
$BaCl_2$	1.06	1.00	0.86	2.86	0.73	0.90
$BaCl_2.2H_2O$	1.24	1.17	1.00	3.35	0.86	1.05
$Ba(NO_3)_2$	1.41	1.33	1.14	3.81	0.97	1.19
HCl, 100 per cent	0.37	0.35	0.30	1.00	0.25	0.31
HCl, 18°	1.33	1.26	1.07	3.59	0.92	1.13
HCl, 20°	1.18	1.12	0.96	3.19	0.81	1.00
HCl, 22°	1.05	0.99	0.85	2.83	0.73	0.89
H_2SO_4, 100 per cent	0.50	0.47	0.41	1.35	0.34	0.42
HNO_3, 100 per cent	0.62	0.58	0.50	1.67	0.43	0.53
$ZnSO_4.7H_2O$	1.46	1.36	1.18	3.95	1.00	1.24
$ZnS.BaSO_4$	1.68	1.57	1.36	4.53	1.16	1.43

Example—One pound of $BaSO_4$ is equivalent to 0.73 lb. BaS or can be produced from 0.42 lb. 100 per cent H_2SO_4 and 0.90 lb. $BaCl_2$.

Table II contains data from the 1918 Van Nostrand Annual and is of value to the lithopone manufacturers.

Table II

—$ZnSO_4.7H_2O$ at 15° C.—		—$ZnCl_2$ at 19.5° C.—	
Deg. Bé.	$ZnSO_4.7H_2O$ Per cent	Deg. Bé.	$ZnCl_2$ Per cent
4.1	5	6.3	5
8.1	10	12.1	10
12.1	15	17.5	15
16.0	20	22.7	20
20.7	25	27.9	25
23.5	30	32.7	30
27.2	35	37.7	35
29.9	40	42.9	40
34.3	45	47.5	45
37.8	50	52.4	50
41.3	55	57.1	55
44.6	60	61.7	60

Table III is of use to the manufacturers using barium sulfide, black ash, and was compiled by the writer in collaboration with A. Lusskin.

Table III

Deg. Bé. at 60° F.	BaS Lbs. per Gal.	BaS Per cent
2	8.486	2.67
4	8.571	4.10
6	8.700	6.21
8	8.827	8.31
10	8.945	10.29
11	9.013	11.40
12	9.082	12.46
13	9.151	13.58
22	9.810	24.42
23	9.890	25.72
24	9.970	27.28
25	10.046	28.58
26	10.135	29.91
27	10.171	31.26
28	10.256	32.64

Chemical Pigments Corporation
Philadelphia, Pennsylvania

SOME CHEMICAL NEEDS OF THE VEGETABLE OIL INDUSTRY[1]

By David Wesson

A large corporation engaged in crushing cottonseed and refining vegetable oils was recently asked by the War Department what were the effects of the war on its manufacturing methods. A request was made at the same time for photographs showing improved plant and machinery as illustrating improvements brought about by the war conditions. The answer that was sent back conveyed the information that in handling the seed the amount of lint cut off was about doubled, and to do this the linting capacity of the mills had to be increased. This called for more power, which,

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[1] Read before the Division of Industrial Chemists and Chemical Engineers, 57th Meeting, American Chemical Society, Buffalo, April 7 to 11, 1919.

with the difficulty in increasing power plants and the scarcity and poor quality of coal furnished, had a tendency to cut down the normal capacity of the mills.

In the refineries, owing to the drafting of many of the chemists and skilled labor, the work was in many instances done at low efficiency, while in the lard-substitute plants the same methods were carried on through the war as before, though attempts were made to induce the Government to use, in both the Army and the Navy, a form of lard substitute which would have saved them from 12 to 14 per cent of cost on packages, with a corresponding saving in freight space.

In the handling of by-products the manufacture of glycerin was stimulated by high prices, which have now faded away, leaving the product uninteresting to manufacture.

On account of the shortage of chemists, research work in many cases had to be dropped, so peace finds the industry very much where it was before the war started.

With the increased cost of living and high prices of the necessities of life there seems to be a wide field for chemical development of the cheaper materials of the industry. When the armistice came the country had on hand half a million bales of cotton linters, which, during the war, were worth $4^{1}/_{2}$ cents per pound, but in normal times are not worth over 2 cents. This material can be made at the rate of 150 lbs. per ton of seed, as in the past, and it is up to the chemist to work this very valuable raw material into useful products.

The cottonseed cake carries 35 to 40 per cent of protein. Some method should be worked out to put this in a digestible form suitable for human food.

In the manufacture of the oil through its various processes there is still room for improvement. This country is far behind in the use of solvents for extraction, and now with benzol cheap and plentiful it would seem that extraction processes are going to play a big part in the future of the industry. There is a need at the present time for their development.

As is well known, the chief chemical used in the vegetable oil industry is caustic soda. Before the war this was almost universally sold on the basis of 60 per cent Na_2O by the New York and Liverpool test. During the war caustic soda was sold all kinds of ways, mostly, however, flat. Most of the large producers adhered to the old-fashioned way of quoting as above stated, while the speculators and others who did not care to go into the intricacies of alkali mathematics sold caustic for so much a pound for certain brands of certain strengths. This, of course, led to a great deal of confusion.

When the writer first left school he was given some caustic soda to analyze and made a report but found it was very different from the bill. It was then that he ran up against the time-honored New York and Liverpool test for testing alkali. Apparently very few young chemists know much about this test, and I venture to say there are a good many old ones, not in the habit of handling caustic soda in large quantities who are no better posted. This test has been in use for the last seventy years and is based on the incorrect chemical equivalent of sodium oxide in which it is assumed the atomic weight of sodium is 24 instead of 23. By this method pure carbonate of soda would show 60.377 per cent, whereas actual Na_2O would be 58.491 per cent. In other words, the New York and Liverpool test shows 3.226 per cent more Na_2O based on the total actual Na_2O present. When this test is applied to caustic soda the buyer has to pay for Na_2O present whether it is there as sodium hydroxide or sodium carbonate.

The only defense brought forward for the New York and Liverpool test is "trade custom," and this is because some conservative firms still like to make the ignorant buyer think he is getting more for his money than he receives.

When a chemist buys caustic soda he wants sodium hydroxide because that is what he uses in his work. It would be a considerable saving in time and trouble to those engaged in the industry if all using caustic soda would specify a definite percentage of sodium hydroxide in their contracts and settle on that basis, allowing nothing for Na_2O as carbonate which, in oil refining, is of no use when mixed with the hydroxide.

With the large capacity of alkali plants brought about by the war and the natural competition for business which is bound to result, it would seem that the time is ripe for relegating an obsolete and worse than useless trade custom to the scrap heap, and it is hoped that the members of the AMERICAN CHEMICAL SOCIETY will do what they can to bring about this result.

SOUTHERN COTTON OIL COMPANY
120 BROADWAY, NEW YORK CITY

FOREIGN INDUSTRIAL NEWS

By A. McMILLAN, 24 Westend Park St., Glasgow, Scotland

MANUFACTURE OF COKE

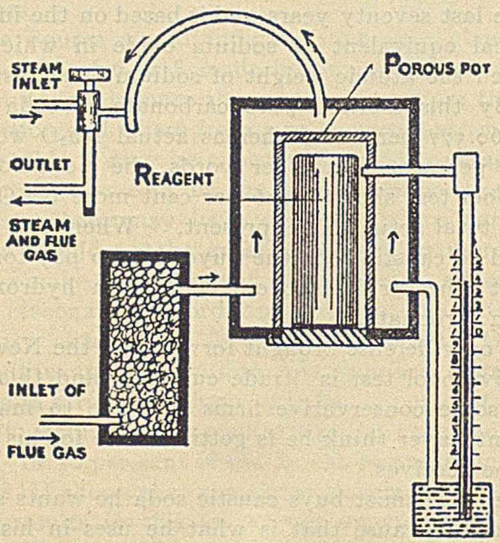
According to an English patent, carbonaceous material, for example, anthracite, peat, lignite, etc., is mixed with the calculated quantity of tar, pitch, petroleum residues or other hydrocarbon required to produce a mixture analytically similar to natural coking coal. The mass is crushed, mixed into a slightly pasty mass and pressed into briquettes in a cold state. The blocks are exposed to the air for about 24 hrs. and are subsequently coked, the volatile constituents being collected as tar, which may be employed for mixing with other material to be coked. The coke obtained has the special properties of metallurgical coke.

STEEL WORKS IN NORWAY

The *Anglo-Norwegian Trade Journal* states that the Minister of Norwegian Industrial Supplies has announced that the government purposes to subsidize new steel works and rolling mills planned in Norway. Loans will be granted and premiums given on production. The latest project is a steel works to be established at Eidjford, Hardanger. A company with a capital of several million kroners has secured water power and sites for the works and will use a new electric process which is said to be much cheaper than methods used hitherto. The water power amounts to 50,000 h. p., of which 10,000 h. p. will be utilized as a beginning.

COMBUSTION INDICATOR

An instrument made by the "W. R." Patents, Ltd., 8 Old Jewry, London, and called a combustion indicator, is designed to give a continuous indication of the percentage of carbon dioxide present in the flue gases of a steam boiler, and thus to enable the fireman to adjust the air supply to the furnace in such a way as to get as complete combustion of the fuel as possible. The essential part of the device consists of a porous pot in which is placed a dry absorbing reagent in the form of a cartridge. A sample of the gases it is desired to keep under observation is continuously sucked from the flue by an aspirator worked by a small jet of steam (in cases where forced or induced draught is not employed) and is passed through a filter into a closed chamber containing the porous pot. Some of the gases in the chamber penetrate the porous walls into the interior of the pot and are there absorbed by the reagent, and the partial vacuum thereby produced inside the pot is measured by means of a water gauge connected between the interior of the pot and the chamber, the scale being so graduated as to permit the percentage of carbon dioxide to be read off directly at any time. The instrument which can be used not only with steam boilers but also for the exhaust gases of gas and oil engines and with gas producer plants is stated to be accurate within 1 per cent and to respond quickly to variations in the carbon dioxide content of the gases. No adjustments are required and the only supervision it needs is the renewal of the absorbent cartridge every other day.



PAPER MATERIAL

Experiments, says a contemporary, carried out at the Imperial Institute, London, show that the husks of Burma rice are not, as was at first hoped, suitable for making paper. The fibers from the husks had an average length of from 0.5 mm. to 0.7 mm. and the pulp contained a large proportion of gelatinous material which could not be satisfactorily removed by heating and washing; the pulp might be used as a filler in admixture with longer fibered pulps for the manufacture of low-grade paper or strawboard.

ALUMINUM

According to the *Revue générale de l'électricité*, the surfaces of two pieces of aluminum if they are to be soldered together should be rubbed down with emery paper with a small quantity of vaseline. The fluid may be made up as follows, according to a prescription given by the soldering association: lithium chloride, 15 per cent; potassium chloride, 45 per cent; sodium chloride, 30 per cent; potassium fluoride, 7 per cent; sodium bisulfate, 3 per cent. The joint should be carefully brushed and washed in hot water to remove all traces of flux.

TESTING FOR SIZING WITH IODINE

Albuminous bodies which include animal glues give with iodine solution, on addition of acetic acid, yellow or brown colors. The reaction must be obtained with an aqueous extract of the paper as well as with the sized fibers. The iodine solution is made by dissolving as much iodine as possible in a 1 per cent solution of potassium iodide. If some of the paper teased out with a needle on the slide is dabbed with the solution, a brown color is produced, whether the size is animal or rosin. If, however, the paper is heated on the slide with a little water and then removed, the dried residue on the slide shows characteristic appearances under the microscope. Animal-sized paper leaves behind a considerable formless residue extending over the whole surface formerly occupied by the water. The iodine solution gradually dissolves it with a rusty red color. If the paper be rosin-sized, it leaves but little residue which shows a grainy structure with an uneven dented edge round the space formerly taken up on the slide by the watery solution. This residue also gives a brown color with the iodine solution. It consists of free resinic acid, according to an article in *Paper-Maker*, 55 (1919), 43, melted out by the hot water and forming an irregular deposit against the dry part of the glass.

IMPORTATION OF CHEMICALS

A proclamation dated June 25 has been issued by the British government of which the following is the operative part: As from and after the date hereof, subject as hereinafter provided, the importation into the United Kingdom of the following articles is hereby prohibited, *viz.*, chemicals of all descriptions; scientific, mathematical, and optical instruments; tungsten powder and ferro-tungsten; provided always that this prohibition shall not apply to any such goods which are imported under license given by or on behalf of the British Board of Trade and subject to the provisions and conditions of such license. The Board of Trade give notice that whereas the above proclamation prohibits, *inter alia*, the terms of the prohibition have been thus widely drawn solely for convenience of a demonstration and that it is not the intention at present to do more than to control the entry into the United Kingdom of certain classes of chemicals of a high degree of purity. The Department of Restrictions will, therefore, almost immediately issue general licenses for a large number of chemicals which are not of this description and they will also issue licenses in suitable cases and for limited quantities of the chemicals which are retained under control. For this purpose, the Department will be assisted by a committee which is now in process of formation and which will contain representatives of official, scientific, and trade bodies connected with chemical industry.

CARBON DEPOSITS

According to *Motor News*, 20 (1919), 1095, Messrs. Shippey Bros., 13 and 14 King St., Cheapside, London, have provided a chemical decarbonizer for preventing deposits on the pistons of motor car and cycle engines, valves, radiators, etc. Its effectiveness results in improved lubrication and more mileage. It gets over the expense and trouble of dismantling and scraping the carbon from the cylinder heads. It is only necessary to put from two to four tablespoonfuls of the liquid into the cylinder every twenty or thirty days, according to the amount of mileage done. This it is claimed keeps the engine in prime order, and lubricating oil may be used as a mixing agent. The makers suggest that about two tablespoonfuls should be put into every quart of cylinder oil used in the crank case or other oil reservoir. The liquid quickly combines with the carbon and by the aid of the combustion in the cylinders volatilizes the same and so removes the carbon.

FIFTH NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES

THE SPIRIT OF THE EXPOSITION

By R. S. McBride

About ten years ago when one said he was a chemist this meant something to anyone acquainted with this science. The Fifth National Chemical Exposition has proven a change from this former condition. Chemistry has permeated all industry, and now when one says he is a chemist, it seems to mean nothing, for it really means so much. This extension of chemistry is the first and most striking of all the impressions received at the Exposition. Every line of industry, every material of commerce, every principle of science, seems to find here effective presentation, in some form or other.

To tell the story of the Exposition in any short space would, of course, be wholly out of the question. But the spirit of this occasion is clear and easy to set forth: Progress, Efficiency, Service. These three stand out above all other items.

As a "mirror of progress" the occasion was a tremendous success: new materials, new products, new processes, new apparatus and new machinery—to tell of it all would be the full story of American success, not only in its declaration, but more still in its accomplishment of industrial independence. This progress too is not set forth so much as a fully accomplished thing, but rather as a splendid start with wonderful promise for the future.

The success of industries obviously depends upon a recognition of sound principles in the building of machinery and a practice of sound business methods. For all of these the chemist and the chemical engineer are in part responsible. Their duty is to fix upon a proper scientific basis, making for efficiency in the whole structure which the industrial man is to build with his trade or manufacture. In the Exposition this efficiency was made a practical affair, not a mere theory or fetish. The means for its realization and the demonstration that the realization is practical were set forth, both in the process and the product. It is clear that the exhibitors realized that efficiency is to be our industrial yardstick.

Moreover, the Exposition was of interest not only to the chemical and related industries, but also to the entire country. By this is not meant that the demonstration would appeal to popular visitors or attract the non-technical public; but to all of the country it had a real significance. In the last analysis the whole motive was that of service. This is really a logical outcome of the effort for efficiency and it is clear that chemistry, both as a science and as a profession, is on the straight road to reach its deserved position among the greatest of all industries. And it is safe to say that it will never lose its position, as long as it remains as now, the servant of all.

CHARACTER OF EXHIBITS

To accomplish so large a function as set for it, obviously needed great care in preparation, and the results of this thought, taste and careful expenditure resulted in a most attractive and instructive set of exhibits. The thanks of the chemical profession are certainly due to those who made the effort to produce this gratifying result.

The exhibits were prepared for the chemist and the engineer, not for the casual sightseer. The exhibitors had carefully prepared material demonstrative of their processes and products in a way that appealed heartily to both the technical men and the business man associated with them in the industry. Those in charge of the booths not only knew what they had there, but better still knew its real significance. They were able to emphasize the improvement in the art to which their exhibit related and to demonstrate the sound relation of their claims to the economics of the business. In this way a great many found valuable instruction for their own line where before they had had only casual interest. Apparently for the first time many appreciated the value to themselves of much of the material shown which seemed at first to lie wholly outside their own field.

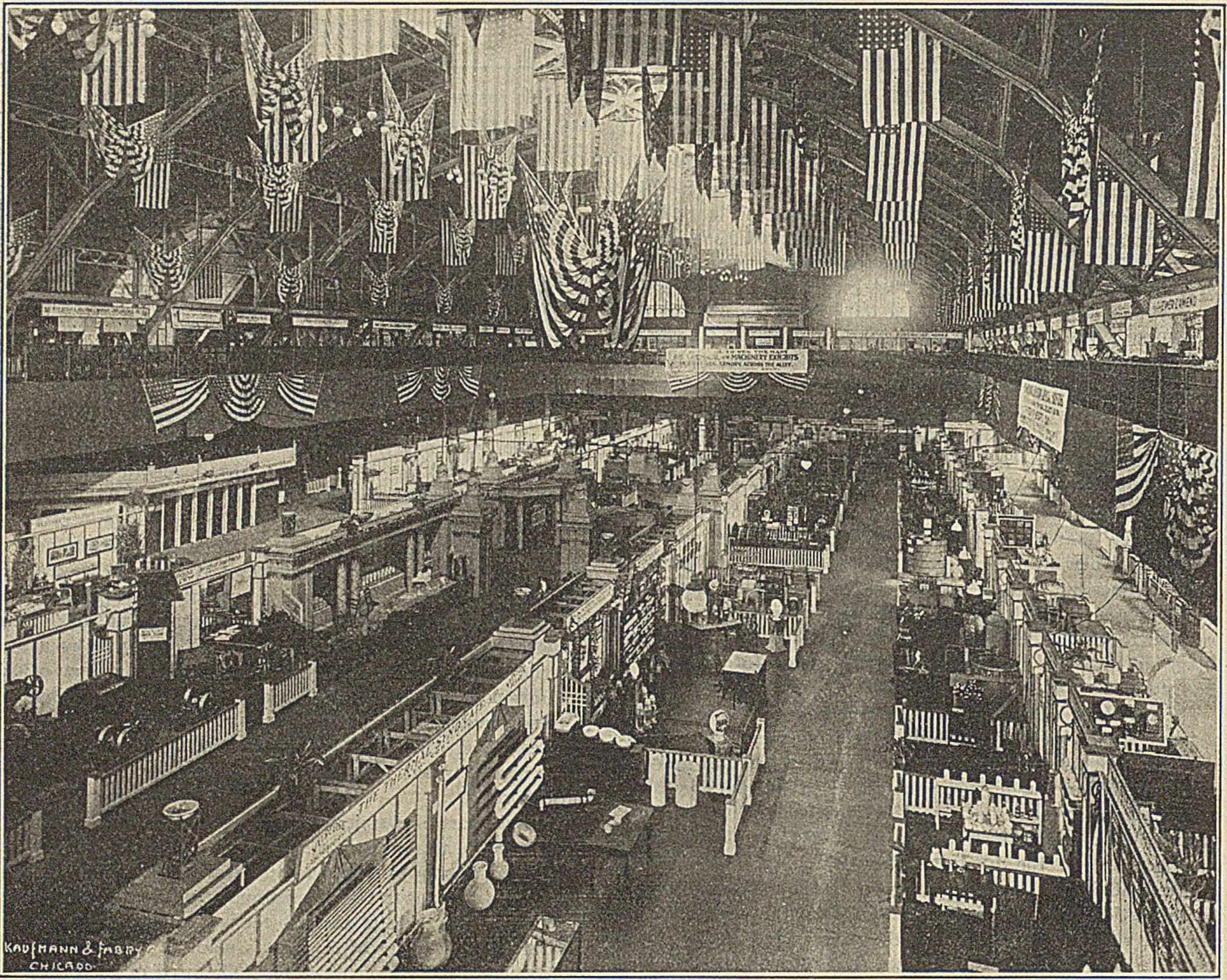
Genuine in appreciation of the spirit shown by the exhibitors was the response of those attending the show. In many cases those in charge of the booths remarked upon the striking contrast between this and previous occasions, in respect to the very limited number of persons who came and asked for information without an appreciation of the need or the value which this might have for them. As one exhibitor said, "We are blessed with an absence of 'rubber-necks.'"

Many new materials and machinery appeared here for the first time, with many older exhibits, well worthy of a second showing. A striking development was the more frequent use of charts with samples of material and models of apparatus to demonstrate the relation of raw material, process, and product. Many new exhibits in actual operation were also shown, adding greatly to the interest as well as to the real value of the occasion. By means of charts a very surprising perspective as to the scope of new and little appreciated fields was given. One striking example of this, in a field probably not fully grasped by many, was the chart of cyanamide, which is reproduced as one of our illustrations. The Barrett Company added renewed interest in their popular chart of coal-tar products, replacing names by samples. The United States Industrial Alcohol Company's chart demonstrated many substitute uses for the late John Barleycorn.

The only part of chemical industry which was not covered by the Exposition related to foods and drugs. It was really an industrial man's show, planned to appeal to the business man and financier as much as to the chemist and engineer. The emphasis on the economic side of the subject was strong, and this was supplemented in many of the points made in the addresses delivered before the various sessions. The need of good business methods in order to prevent error and loss, which was made clear so effectively by Mr. Dow in his address, had evidently guided much of the preparation. This indeed was one of the most hopeful aspects of the occasion as a permanent institution.

One of the remarkable features was the change in attitude of many of the visitors during their stay. Nearly all came with the expectation of not taking home any pamphlets or literature given out by the exhibitors, but this attitude quickly changed when the genuine value of such was noted, for data and principles of processes were clearly set forth in an attractive way and even those most objecting to carrying a bunch of pamphlets could not resist the appeal. The pamphlets were not at all "popular" in nature. They were built to show that the subject demonstrated really could "deliver the goods." It was a very satisfying evidence that the chemist is now practicing what he has long preached, buying upon specification, analysis, or guaranteed performance. No longer is the skill of the salesman sufficient to sell; real merit is taking its deserved place.

The scope of the exhibits extended from the test tube (yes, there really were test tubes there) to full-size industrial equipment even as large as nitrating kettles of a capacity to circulate five thousand gallons of liquid per minute. Apparatus of the finest sort to give specific gravity to the fourth decimal place and balances that were sensitive to one hundredth of a milligram vied with large-scale measuring equipment, even up to that of two million cubic feet of gas per hour. Delicate physical apparatus on the one hand and laboratory furniture on the other also were there to show that the research man could find any type of equipment which might be of interest in his line as well



as others. Our American independence of foreign manufacturers was most encouraging.

As a reward for their effort the exhibitors were shown by all present an enthusiasm and optimism which was most satisfying. The attendance, at all times, was good, showing that the estimate of twenty thousand interested people in Chicago for this Exposition and the five conventions held simultaneously was probably conservative.

All in all, the first National Chemical Exposition to be held in the middlewest should be acclaimed a great success. This section of the country has fully appreciated the occasion and has made the most of it. They have set a high standard which the next exposition will have difficulty in excelling.

Washington, D. C.

THE CHEMICAL INDEPENDENCE OF AMERICA AS SHOWN AT THE EXPOSITION

By Procter Thomson

The chemical independence of America is often thought of in terms of those industries that have been developed during the war. These represent only a part of our independence. The Fifth Exposition of Chemical Industries was impressive in its showing of the completeness of the development of American chemical industry.

Those industries whose development has completed our independence were well represented. The by-products coke industry has reached the point where plentiful supplies of organic raw material are assured, so plentiful that benzol, toluol, xylol mixtures are offered as a motor fuel at a price that competes with gasoline. The production of naphthalene is so great that we now have a surplus for export. Paracoumarone resin of American origin is now available at a low price. A number of well organized companies with the proper financial backing are offering intermediates. These make it possible for the American manufacturer to consider the production of synthetic organic products with an assurance of regular supply.

The number of firms offering dyestuffs was slightly greater than last year, and the lines of dyes available are more nearly complete. With some few exceptions, American dyes are ready to meet all demands. The dyes not now produced are being developed and the time is not far off when complete independence will be attained.

The Exposition was notable for the number of synthetic pharmaceuticals, flavoring extracts, and similar products offered. It is to be hoped that protection will be given American manufacturers in this line, so that our independence can be maintained.

In another line—rare metal products—the growth was noticeable. American-made tungsten, molybdenum, cerium, vanadium, uranium, and titanium, as metals and as salts, are available for commercial and research use,

For research use also there were exhibits by firms which are producing rare bacteriological sugars, bacteriological stains, organic chemicals, and other materials that have formerly made

American research laboratories dependent on foreign sources. Chemical independence is dependent upon these American manufacturers in a way that is not generally recognized. Laboratories, both research and educational, in their search through the literature find references to various reagents under foreign trade names. The people supplying American research chemicals should get proper recognition in order that the ordering of foreign stuff—merely because the literature mentions it—may be discontinued. Then our students and our research men will be extending the science of chemistry with American materials and American ideals.

American-made glassware, porcelain, and filter paper were shown by manufacturers and dealers. These products are of considerable merit and were developed to meet war time needs. The future of American-made laboratory supplies is in the hands of the American chemist. We believe that he realizes the importance of complete independence so strongly that this future will bring great development.

But the products developed in the last few years do not represent all of American independence, although the spirit which has guided this development is the principle feature of our independence. Before the war we were producing inorganic chemicals in large quantity. Our electrochemical development was well advanced. Our ferrous and nonferrous metallurgy was such as to make the American mining engineer and the American steel producer the envy of the world. The exhibits at the Fifth Exposition of Chemical Industries showed American chemical independence not only in those lines which have rounded out our freedom but in those lines which are the foundation of industrial liberty and in which we have been independent for many years.

Chicago, Illinois

SESSIONS OF THE EXPOSITION[1]

THE WELCOME

Speaking for Chicago and the Central States, Dr. L. V. Redman, chairman of the Chicago Advisory Committee of the Exposition, expressed a welcome of the Exposition to Chicago which was made genuine throughout the whole week. It was with obvious pride in Chicago as a center of chemical industry, that he spoke of the confidence of growth here of all lines of technology. Conspicuous in the whole Exposition was the fact that so many of the exhibitors represented this district of the country.

Citing the spirit of progress in arts and sciences, Dr. Redman set forth the conclusion that during the war period each year had represented as great an advance as would ordinarily be accomplished in a generation, and defied those who viewed the Exposition to deny this. He also pointed out that the increase in activity of chemists, bringing greater demands, has augmented chemists' wages.

This Exposition referred largely to the result of the application of research upon basic principles as a means for successful advance. In this connection Dr. Redman found much to rejoice in the recent resolution adopted by the American Federation of Labor at its national convention, at which time research by the Government was recommended. He found much satisfaction in this first recognition by labor of the basic significance of efficiency in production, and the acknowledgment that distribution is not the sole factor in determining living conditions.

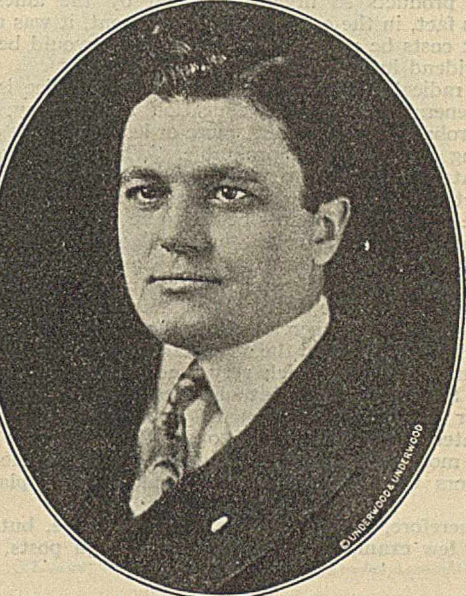
FOR THE MANAGEMENT

Speaking on behalf of the exposition authorities, Charles F. Roth one of the managers, set forth the principles which have guided the work needed to make so great a display of chemical success. He pointed out that the business which is not founded and conducted on a sound chemical basis with modern, efficient chemical equipment will be a laggard in the commercial race. The effort of the Exposition is to serve a great American commercial need through the members of the chemical profession. In pointing to the ever-increasing part chemistry is playing in the great industries of the world, he said:

> American chemical engineering has shown during the past four years its ability to meet all emergencies and the competition of its enemies. There are many manufacturers who do not realize that their organizations are founded upon some chemical reaction, for the chemical industries are those founded upon the basic principle of transforming some raw substance or material by a change in its constituents to some material useful for the comfort of man.

After enumerating a long list of chemical industries, many of them not generally connected by the public with chemical arts, Mr. Roth continued:

> Did all business men sense the value of a chemical study of their industries and place them upon a scientific basis, the result would place our domestic industries in an unassailable position, incomparable with the rest of the world, for the efficiency of so enlightened a procedure would reduce costs of production by elimination of wastes, obsolete machinery, long and tedious methods, the employment of unnecessary materials and a hundred and one other causes. Competition by any other country would be impossible until they had reached a similar stage of development.



Charles F. Roth, Manager National Exposition of Chemical Industries

> Inquire of the leading firms in every industry for the reason of their leadership. They know that the application of the imperative laws of chemistry to their operation has brought it about. The greatness of Chicago's packing houses lies more in the chemical utilization of the waste than the shipping of the prime product. The greatness of the gas house is not in the gas, but in the dyes and pharmaceuticals made from the tars it recovers.

FROM TEST TUBE TO DIVIDEND

Meeting the general interest in the chemists' problems as a commercial project, Herbert H. Dow spoke at length from his experience, taking as the subject of his address the vital question, "How Long Does It Take to Develop a Laboratory Process into a Dividend?" In his treatment he drew telling examples from the problems that occupied the six years from the summer of 1888 during the development of the bromine process of the Dow Chemical Company and the ten years spent in perfection of methods which fortunately matured to fruition within thirty days of the opening of the European war, when magnesium chloride was sent out in carload lots.

That all the promising efforts were not ever perfected to the plant stage was made clear by citing the experience with a brombenzol method for phenol production. Paralleling this, however, was the unusual success with an old method described as follows:

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[1] We are indebted to Dr. R. S. McBride for the preparation of this and the following material from the Exposition.

> The first plant built had an estimated capacity of one ton per day. It turned out its first product on the first day of November 1915 and in this 30-day month produced 59,000 lbs., which was only 1000 lbs. short of the capacity which had been estimated from the small scale plant. This was the first time in our history that we had gone from a semi-manufacturing plant to a real manufacturing plant without experiencing troubles and months of delays. We attributed our success to a much larger and more mature development organization, and the further fact that after an organization once learns how to develop one chemical manufacturing process, it is much easier to develop another. In this case, the laboratory process and the dividend were less than one year apart, but we must take into consideration that the very abnormal war prices made a profit much more quickly obtainable. * * * *
>
> A high official of one of our largest electrical companies once stated to me that they had to figure on five years from the drafting room to the dividend on any product which was materially different from their normal line. The fact that the United States Government during the war could actually accomplish in six months or a year what an old experienced organization could not accomplish in a much greater length of time can only be explained on the ground that men of very unusual ability, and in much greater numbers than any commercial enterprise could command, were giving their services and the utmost energy which they possessed to the rapid development of these products so urgently needed by the allies. Aside from this fact, in the case of the Government, it was not necessary that costs be reduced to a point which would be essential for a dividend in a private enterprise. * * *
>
> In all radical inventions, where public prejudice is a factor and a general campaign of education is necessary, it would appear probable that 10 years, more or less, would be consumed in making a new process profitable. While there are a great many statements in regard to the great length of time required to perfect the first indigo process, there are no data that tell when the earlier small plants began to be profitable. It is now more than ten years since the first indigo was made in one of the laboratories of the Dow Chemical Company, but no serious effort was made to commercialize this process until after the war started, and about three and one-half years after it was decided to build a commercial plant the process became profitable. However, we had the advantage of much of the previous work done by others, which very much shortened the time required. Future development organizations will have the aid of better laboratory equipment, more perfect organization and greater experience, but to offset this, processes in future must be more highly developed in order to meet the prices of competitors who are continuously making their plants more efficient.
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> We, therefore, leave it to yourselves to judge, but we trust that the few examples given may act as sign posts along the way.

Another point of much interest as a guide from the experience of this speaker was his review of the stages in process perfecting:

> It is our experience that the method of evolving a successful process is somewhat as follows: The laboratory works out the process and compares it with the state of the art as shown in the literature, and if results would seem to justify the effort to make the process commercial, some further laboratory investigations are carried out, and then the laboratory force, without an exhaustive study of the subject, tests it out in a semi-manufacturing plant, made of commercial materials instead of glass and porcelain. Here a number of new problems will present themselves and will have to be worked out by the research men. After this plant is in successful operation, the draftsmen start their work for a large plant. In the meantime, any uncertain points are still being investigated by the research organization, but an exhaustive study of the subject is not made in the research plant, as we have found by experience that there is no limit to the investigations that may be made at this stage, and many of the points which might be worked on would take months of valuable time which could better be employed at other work, even if we take some chances on a process not thoroughly developed. Finally, when the commercial plant begins to turn out a product, it is inevitable that certain details will have again to be worked upon by the development organization and the troubles remedied. Of course, in developing any new process, it is necessary to carry the laboratory work to a point where both the purity of the product and the yields are sufficiently satisfactory to make a commercial success; and a few hours spent with beakers and test tubes in the laboratory may be the means of saving days in the semi-manufacturing plant; and in a similar way, it is much cheaper to perfect a process in this semi-commercial plant than in the ultimate commercial plant.

In all this another important warning entered, the need for the business sense in chemical developments and marketing. Not a few got on the rocks for lack of this and needlessly so.

INDUSTRIAL RELATIONS

John W. O'Leary, president of the National Metal Trades Association, added much of inspiration to the evening's proceedings. His entire address is worthy of careful thought.

INDUSTRIAL PATRIOTISM

By John W. O'Leary, President National Metal Trades Association

No invitation to meet the men of any profession or branch of industry has appealed to me as much as yours, and I am happy that the privilege has been accorded me to participate in the proceedings of this meeting of the National Exposition of Chemical Industries.

I have always tried when thinking in terms of the Great War to dwell not so much on its cost in money, in health, sacrifice or supreme loss of life, but more on the gain to the world through the war. It would be unfortunate if we forgot the debt we, as survivors of the awful struggle, owe to those who fought the good fight and won for us world liberty. None can do them too much honor, and we would be ingrates indeed if we failed in our daily life and expression to give thanks to God and them for the victory.

It seems to me, however, that we would be showing small appreciation and little reverence if we now only devote ourselves to acknowledgment of our debt by erection of monuments, memorials to those who won the war. The cost was too great, the struggle too long, to be content with such expression. We should rather feel the duty ours, to honor them by accepting as our task the rebuilding of the world resources destroyed, the conservation of the resources remaining, and the preservation of the lessons taught by experience.

To you men of the chemical industries comes the opportunity to lead in these tasks. The war brought to all of us a realization of your value in almost every branch of industry. One of the oldest of professions has come into its proper sphere of importance. For, during the war, whether the need was a greater destructive explosive, a more dangerous gas, a more brittle steel, or a more ductile, the science of chemistry was the agency to which we looked. Or if the demands of armies called for more cloth, or wood, or paper, or leather, or silk, or anything which natural resource or productive capacity could not supply, the chemist was called on to create the substitute.

And now that we are realizing the effect of interrupted production, and of wholesale destruction, when we are realizing the economic cost, and the difficulty of supplying even our current needs, when we know that it is essential that we also restore the lack in these years of war before equilibrium can again exist, what an opportunity is yours—to serve the world!

The awakening of industry in general to its need for your assistance was marked during the years immediately preceding the war. The twentieth century began with such an appreciation.

I have been interested all of my life in the steel industry. I have heard my father speak so often of the shipment of steel rails to the United States from England during his early manhood, and of the excitement over the discovery of the Bessemer process. I have watched with interest the later development of the open hearth, and the impetus which that development gave to the industry. But it was not until the chemical engineers developed the use of alloys in steel, and the wonderful magic effects of heat treatment, that the full possibilities of the steel industry became apparent. To-day the chemistry of steel makes us feel that no matter what phenomenal results have been demonstrated recently, more phenomenal results will occur, and that there is no more important factor in the further development of the steel industry than chemistry. But it is not sufficient that you have improved materially the quality and uses of steel. You have been developing at the same time the by-products, which for so many years were wasted. In so doing, you are making us independent of Germany and her tar compounds and adding materially to the wealth of the United States. It is noticeable that while almost every commodity has increased in price since the armistice, that steel has been reduced, and that in spite of higher costs in actual production of the steel itself. This has been made possible largely through the utilization of the by-products. It is entirely within the realm of possibility that the by-products of steel manufacture may bring profits equal to those of producing steel. Whatever the gain, it will mean much to the future prosperity of the United States. To-day, we are the only great producing nation in position to carry on normal industry through finance, natural resource and comparative immunity from destruction of life from the war. While we are not taking full advantage of our position, because of industrial strikes, we will recover quicker than others. Eventually, however, we must meet competition which will demand the keenest efforts. The farther we advance in utilization of our by-products to carry the cost of manufacture, the better we will meet whatever the balance of the world offers in competition. What has been accomplished in the steel industry is indicative only of the importance of chemistry in almost every basic line. The extravagant, wasteful methods which we employed in the use of our forest resources is forcing attention now. Through the use of preservatives we must conserve what we have left; and it is your province to develop those preservatives.

The importance of the growth of your industry in the basic field of chemicals, drugs and dyes, is clearly shown in the comparison of our export figures for those articles in 1913 and 1917. Our imports from Germany in 1913 amounted to $21,000,000, our exports in 1913 to all countries $30.000.000; while in 1917, partly due to higher prices, but still representing large increase in volume, our exports amounted to $188,000.000. Surely no other American industry can show such a ratio of increase. The war gave both impetus and protection permitting this vast expansion. American initiative, courage, and legislative protection must be forthcoming to continue onward progress.

And so I might continue if time permitted to enlarge upon the importance of the relationship of chemistry to industry. You know, better than I can tell, how vital your field is to industry. But what of the preservation of industry itself? It seems to me that our industrial progress has for the past year been backward rather than forward, and no gathering of business men at this time should fail to recognize the seriousness of our present trend, and seek for the cause and cure.

During the war, and more particularly since the armistice, we have been passing through successive stages of higher wage demands, higher profit demands; less hours, less work; more leisure, more extravagance; less responsibility; less patriotism; of course, the result is bringing higher costs, and a progress toward disaster. Economic truths have been discarded for theories which sound well but won't work. We are confused by a plethora of general terms, undefined in our own minds or in the minds of those who utter them. Living wage, collective bargaining, profiteering, labor as a commodity, partnership of capital and labor, the right to organize, shop representation, combination, a new era, democracy in industry, socialization of industry, are some of the terms used each day in every publication, in every forum. No one attempts to define what is meant, because every one has his own interpretation, and they nearly all differ.

The great mass of American workingmen just want to work; the great mass of American employers just want to produce. They both recognize that they are interdependent and have coöperative interests, and if permitted to carry on, other conditions will correct themselves. But they too are confused by what is after all nothing more nor less than an insiduous Socialistic propaganda. Not that all who are striving to express their understanding of the multitude of new thoughts are Socialists. Many are honest, well meaning folk who have assumed a paternal interest in industry but are in no way responsible for its continuance, nor have they any practical knowledge of its conduct. Others are selfishly interested in the propaganda because it furnishes them their daily bread. Others are employers who either through conscientious belief or pressure have adopted new plans of relationship and are anxious that they not conduct their experiment alone. And industry suffers! Five months of honest productive effort of American industry will supply all of our own needs, and permit of seven months' effort toward replenishment of the world. Yet at our present rate of progress, we are unable to supply our own needs.

John W. O'Leary, President National Metal Trades Association

Until recently, all Europe was pursuing similar tactics. Each nation's industry was striving to emulate the progress of Russia under Lenine, who has put into force all of the theories which we are talking about, as he understands them. I do not know whether his interpretation isn't likely to be as correct as any of ours. But to-day at least two of the nations who have been passing through this after-war orgy are recovering. Belgium is no longer striving to see how few hours she can work, but rather how many hours bodily strength and health will permit. Germany, under pre-war conditions, a wonderful industrial nation, has lost heavily in man power. But before the war 3,500,000 of her men were constantly removed from industry for military purposes, and millions more were engaged in supplying those 3,500,000. To-day there is no such drain on her industrial man power and the release of this burden more than offsets her losses during the war. They have stopped talking about the eight, seven, or six hour day, and are ready to devote ten, eleven and twelve hours a day to restoring her industrial position.

Frankly, men of American industry, it is time we woke up and undertook a larger influence in the guidance of our industrial program. Whether or not we are living in a new world, or a new era, the same sun shines, the same God rules. None of the formulas of chemical reaction have changed. We continue to progress in the discovery of new things, but they do not develop over night. Time and honest effort, not laws or theories, will make the discoveries available for service. Progress must be step by step, and each step will succeed only as the proper reagents are used. I remember from my days in chemistry that it required hydrogen and oxygen to produce one of the necessaries of life; that it required two parts of the hydrogen and one of oxygen to accomplish it; either a different element or different proportion meant failure. If we substituted sulfur for the oxygen we made an awful stench.

As I see it, industrial relations operate similarly to chemical relations. To reach proper results we must rely upon employer and employee, and in their proper proportion. Too much power on the part of either will not make the compound desired. The substitution of another element will make a stench, and the addition of another element will not produce the desired result.

Two weeks from to-day the Labor Conference called by the President of the United States will assemble in Washington. Its importance to industry is emphasized by the request of the President to union labor to await results of the Conference before inaugurating further strikes. The corollary is that if results of the Conference do not follow the desires of the Federation, strikes will follow, and we must continue the disastrous experience of the past year. It is important, therefore, to analyze from the President's speeches and trend his views on proper solution. He has expressed his belief that society sanctioned the eight hour day; he has approved collective bargaining, though not clearly defined as to method; he has said that he would offer a new basis for wages; he has indicated that workmen should be partners in industry; he has advocated placing employees on the Board of Directors; he has shown sympathetic approval of the organization of all workers.

As I indicated earlier, much depends on the interpretation we give to terms or words. Under any interpretation, a program based on immediate adoption by American industry of these principles would result in chaos. Unrest is too keen for the launching of any definite plan of development of theories which, whether good or bad, must be gradual in their presentation, adopted only after experiment in a small way has proven their success, and debated and studied when men are calm and their judgment keen, rather than under hysterical and restless conditions.

I hope, therefore, that all men of industry who meet together, whether employer or employee, will consider the seriousness of our industrial future, calmly and without passion, and I hope that as a result of such thought they will express to the President their hope that in this critical period of unrest no radical suggestions be inserted to further complicate conditions. Industry is in no position to absorb further departures from established practice than are now being tried. The general public cannot add to the burden being carried by them. Increased production is the only method which will make permanently possible improved standards of living or working conditions.

Our greatest need to-day is for a reawakening of the patriotic impulses created during the war. Now, the slogan should be "Industrial Patriotism."

AMERICA'S CASE IN CHEMISTRY—A SYMPOSIUM

Inspiring his hearers with a vision of the future and chiding them with their duty but partly done, the chairman, Ellwood Hendrick, developed his subject from the early history of American chemistry. Drawing telling contrasts between our technical and our political development in this country, the speaker set forth his appraisal of the situation and then made clear the duty of the chemist to industry, as follows:

The profession, I repeat, was out of focus. We did not have chemists enough because the subject was not talked about enough. Now the special bent of brilliant minds is not always disclosed in youth. They have to feel their way along until they strike their *metier;* and it goes without saying that many a brilliant mind would have addressed itself to chemistry had the subject enjoyed the general consideration which is warranted by its importance. Chemistry was, in fact, a learned profession long before the tradition lost weight that law and divinity were the only suitable callings for a thoughtful man. When the Great War came upon us the eyes of the people were opened. Chemists were suddenly needed, needed as never before; and how ours responded, the world knows.

Industry has taken notice of chemistry, but it has not yet completely wedded itself to science by availing itself of its opportunities. There is need of many more general commercial laboratories than can find support. We need more industrial research. Again, we have not yet learned the need of men with trained scientific minds on boards of directors of corporations engaged in chemical manufacture. This is a serious defect, and its results are frequently shown in the inertia of industry in failing to profit by improvements that would make for great economies as well as for advancement in well-being. Most of us are familiar with large industrial establishments, the processes of which are based on chemical reactions, and these corporations are operated from the standpoint of salesmanship, banking, and law. The company's legal adviser sits in council to pass upon contracts and procedure in dealings with men, but the chemical adviser who understands materials, and who, therefore, is responsible for the company's products and its good repute, is generally left out in the cold. American industry at large, with only a moderate number of exceptions, is still deficient in its calls upon the man of science to its councils.

Whenever such calls are made the American chemist has responded and has set himself to work with diligence. That so many of his efforts have been crowned with success is pleasant to contemplate—but the way of progress does not lie in contemplation alone. We are in the race with the wide, wide world. In some respects we are ahead, and in others we are behind. We cannot lean back and fold our arms in the belief that a high protective tariff will assure us success. We must maintain the coördination between pure science and that which is applied. We must hold up the hands of our great teachers and encourage them in their arduous talk. We must increase the honors and distinction of their offices, and make the post of teacher as desirable as possible. We must do what we can to discover the exceptional man, and to create opportunity for him, because often the exceptionally gifted in research lack the gift of finding places for themselves. We must preach the gospel of chemistry, and bear its evangel to spots where its light is still unknown. And we must, in one way or another, conjure up the "voice of authority" so that it may speak for us!

We need the voice of authority to put a stop to waste of power, waste of fuel, waste of wood, waste of materials, waste of labor—and waste of men. We need this voice to point out the ways of progress.

I believe that we can conjure it up, not as the utterance of one individual, nor in the shout of thousands of voices, crying in unison. It will come, but rather in the benediction of things done. I believe we can accomplish it if, as chemists, we interest ourselves intensely in public affairs, struggling with all our might, both individual and collective, for the public weal; by doing this daily, and without thought of personal reward. If we dig into public affairs with diligence, preaching the gospel of chemistry with all the ardor of insistence shown by the Ancient Mariner in telling his weird tale, then, in time, our message is bound to be heard and heeded. Indeed then, with God's help, we may advance toward a greater enlightenment with a better art of living and in a better ordered world, where justice and peace abide.

Dyestuffs

Dr. J. Merritt Matthews speaking of the dyestuff situation in this country first contrasted the present large exports with the imports of a few years ago, pointing out that now we send out dyes valued as highly as those which were imported in corresponding periods before the war. The number of products already available for the trade and the number of establishments connected with the business give assured success in this field if the protection needed for a time at least is afforded. The basic nature of this field and its interrelation to other industries was also made clear.

Following a brief review of some of the misconceptions as to dyes and as to the characteristics which are of commercial importance, Dr. Matthews seemed to find for all a most satisfying sense of the availability of the colors needed when he pointed out that despite the practical cessation of the imports of dyes we do not find any lack of brightly colored fabrics and materials to serve the bulk of the commercial need. In contrasting the situation here and abroad he said, "It takes time to do all this, but the United States is no worse off than any other country in this particular."

Chemical Porcelain

Speaking of the history and the present status of the chemical porcelain industry, Herman S. Coors made clear some of the manufacturers' problems and interests. He said:

> I am very glad of this opportunity of speaking to you regarding a subject which is of vital interest to me and which, I believe, is of interest to all of you. I am here to help secure the continued support and coöperation of you American chemists, asking your aid toward the perpetuation of all industries which in the space of four years have arisen from obscurity to a position of national importance. * * *
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> In conclusion, permit me to suggest that the art—as applied to chemical porcelain—is better than the article. The knowledge of how to produce is infinitely more important and valuable than the thing produced. The skill we now possess, which cannot be taken away from us, will continue to exert itself toward the production of chemical porcelain, provided you help to foster our interests and give us your material encouragement.
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> If we wish to preserve the strength and impregnability of American production, we must direct the growth, within our own country, of the wide and varied catalogues of our industries and sciences. We must develop and train the creative faculties of our own country instead of those of foreign lands.

Optical Glass

H. E. Howe, of the National Research Council, speaking in place of H. N. Ott, told the story of optical glass as a war-time development. Pointing out the fact that previous to the war there had been no incentive to make optical glass, he made clear why trade secrets had governed this industry in this country. But as the war demand arose it was quickly proven that science was more efficient than trade secrets, and the scientist, coöperating with the technologist, was able to produce all and more than the need of this country for optical glass. There was thus produced over 675,000 pounds, and at the end of the war period the production capacity had reached the astounding total of 105,000 pounds of glass per month.

The chronological development, whereby the six important kinds of glass needed in quantity were thus made available, despite tremendous difficulties, afforded a most interesting record in America's war achievements.

Laboratory Supplies

J. M. Roberts, secretary of the Apparatus Makers Association of the United States, spoke on the subject, "Laboratory Supplies; Instruments of Precision and Graduated Glassware." In this field Mr. Roberts pointed out as one of the most urgent needs the standardization of equipment, so that various makers' apparatus would precisely duplicate in every important characteristic with apparatus made by his competitors for the same particular purpose. He stated that, at the present time, many instruments of precision were being built in this country far superior to the types previously imported. With proper protection against importation this condition, in Mr. Roberts' opinion, assures complete success in supply of precision equipment for the laboratory.

Glassware

E. C. Sullivan presented a very interesting summary of the various types of commercial glassware which have been developed to establish our complete independence of foreign makers in this field.

He discussed not only laboratory ware and that which goes into general trade use, but many specialized types such as railway signal globes, lenses for signal lanterns, lamp-bulb glass, glass for protecting the eyes against ultra-violet, infra-red and other rays that destroy the sight. It is unfortunate that the demonstration of these glasses, which had been prepared, was not possible under the circumstances of the presentation.

Inorganic Chemicals

W. D. Collins gave particular attention to the question of the need for more pure inorganic chemicals, especially from the standpoint of reagents. Many of the heavy chemicals and insoluble inorganic products can be made with full success, and Mr. Collins prophesied a rosy future in this field. He pointed out one difficulty, however, namely, that one could not, as is sometimes required on government purchases, base his order upon the lowest bid, since quality, of course, is often much more important than price.

Research Inorganic Chemicals

H. T. Clarke, telling the story of independence in the field of little used chemicals needed in research work, made the following comments:

> At the opening of hostilities in 1914 the supply of imported research chemicals in this country was abruptly cut off. Research work continued for some time with the use of materials in the stock houses and in the storerooms of the universities, but by the middle of 1916 the condition was rapidly becoming serious and it looked as though research work was coming to a halt for lack of supplies.
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> During this period one attempt was made by a university laboratory to meet the shortage in its stock rooms. Dr. C. G. Derick, of the University of Illinois, initiated a system of vocation laboratory work for the senior students in the organic chemical department, in which the materials most urgently required for the work of the coming semester were prepared in quantities sufficient to meet the immediate requirements. * * *
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> In July 1918 a letter from Prof. R. A. Gortner was published in *Science*, appealing for an endowment of a laboratory in which this work could be carried out on a more extensive scale. It appeared in the Eastman Kodak Company that their laboratory was in a favorable position to undertake the preparation of synthetic organic chemicals, and approval of the AMERICAN CHEMICAL SOCIETY was obtained, while ample assurance of support was readily given by the large chemical manufacturing firms in the country. Owing to the scarcity of chemists at that time it was decided to staff the laboratory entirely with women, both as chemists and as assistants, and this plan has been adhered to throughout the progress of the work.

TECHNICAL SESSION

The technical session of the Exposition on Thursday afternoon under the chairmanship of Dr. Wm. D. Harkins, included several important papers. H. E. Howe described the organization and plans of the National Research Council, with special reference to industrial development; his report and that by E. W. Washburn on "The New International Union of Pure and Applied Chemistry" covered information already familiar to readers of THIS JOURNAL.

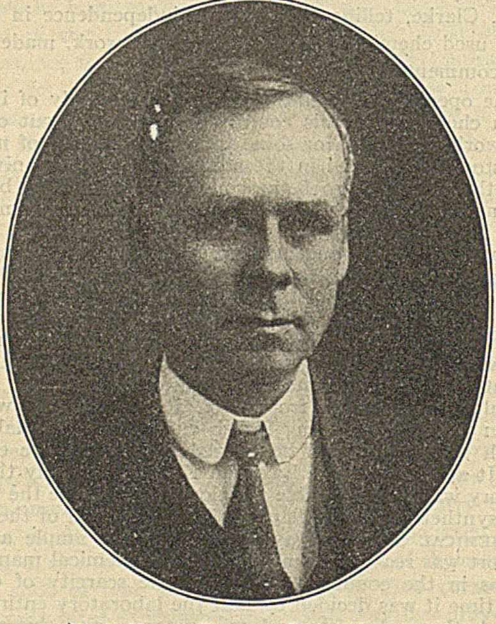
"Fields for Industrial Development; Canadian National Railways," was the subject of an address by C. Price Green, the industrial commissioner of these railways. Many of the industries already beginning work in this field were mentioned and attractive prospects shown for other lines of chemical industrial development.

Henry B. Faber spoke on "Filtration and Filters;" his review of the field included a very interesting discussion of the principles in this line of technical operations.

WILLARD GIBBS MEDAL AWARD

On Friday evening, September 26, the Chicago Section of the AMERICAN CHEMICAL SOCIETY made the award of the Willard Gibbs medal to Professor William A. Noyes, of the University of Illinois. This medal is awarded annually for distinguished original research in some field of chemistry and this year this occasion was made part of the exposition week activities so that many more than usual were able to participate in the banquet and evening of addresses. Dr. Redman, chairman of the local section was the toastmaster, and the award of the medal was made by Dr. Nichols, president of the SOCIETY.

Dr. Noyes is a leader in chemical thought in this country, known not only as an investigator but as a teacher of rare ability. He was born in Iowa, on November 11, 1857, and was educated at Grinnell College and Johns Hopkins University, receiving the Ph.D. degree from the latter in 1882. He later continued his studies at the University of Munich. His teaching experience commenced at Grinnell College in 1879; he then taught successively at the University of Tennessee and at Rose Polytechnic Institute. From 1903 to 1907 he was connected with the Bureau of Standards at Washington, and since 1907 has been Professor of Chemistry and Director of the Laboratories of Chemistry at the University of Illinois.



W. A. NOYES, WILLARD GIBBS MEDALIST

Dr. Noyes has held important offices in the AMERICAN CHEMICAL SOCIETY, including the secretaryship, 1903 to 1907, and as Editor of the *Journal of the American Chemical Society* from 1902 to 1917. To him also belongs the credit for the organization of *Chemical Abstracts*. He has himself published a large number of scientific papers representing research work covering a broad field of subjects. In 1908 he was awarded the Nichols Medal by the New York Section of the AMERICAN CHEMICAL SOCIETY for his work on the atomic weight of chlorine. His published works include several textbooks, which are recognized as authoritative in their respective fields, on qualitative analysis, organic chemistry and general chemistry.

Professor Noyes is a member of the National Academy of Science, the American Philosophical Society, and a Fellow of the American Academy of Arts and Sciences.

The customary address in acceptance of the award was made by the recipient, and will appear in a later issue of the *Journal of the American Chemical Society*.

POSITIVE AND NEGATIVE VALENCE

ABSTRACT OF MEDAL ADDRESS BY W. A. NOYES

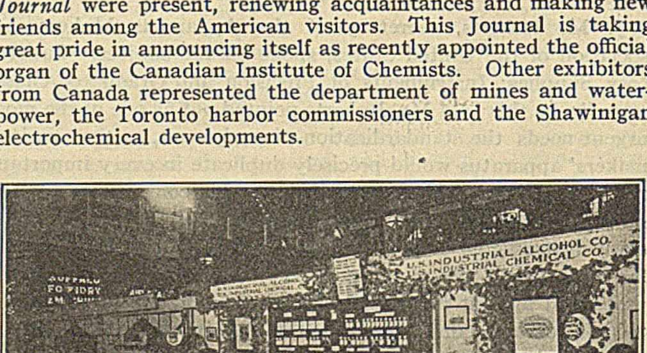
During the first half of the nineteenth century chemistry was dominated by the old electrochemical theory of Davy and Berzelius. This was abandoned after the discovery of the chloro-acetic acids, in which positive hydrogen is replaced by the negative chlorine, and the theories of valence and of structure were developed without any reference to the thought of electrical forces. Since the introduction of Arrhenius' theory of ionization, and especially since the discovery of electrons and of the disintegration of atoms, new electrochemical hypotheses have been proposed and chemists and physicists are now actively trying to decipher the structure of atoms and attempting to discover the nature of the electrical and magnetic forces which are almost certainly connected with chemical affinity. The supposition that atoms consist of electrons arranged within a sphere of positively charged matter seems to have been disproved by Rutherford and others and every one seems to assume that atoms consist of a positive nucleus, or of positive nuclei, around or between which electrons are in rotation or in a vibratory, nearly static condition. The hypothesis has been proposed that an electron from one of two electrically neutral atoms might hold these atoms in combination by rotation around two positive nuclei located in parts of the two atoms. It can be shown from a calculation of the known volume of sodium atoms that the kinetic theory would lead us to expect an orbital rotation of an electron during a period of the same order of magnitude as the vibrations which produce the sodium line in the spectrum. For this and other reasons it seems more probable that atoms contain rotating electrons than that the electrons are in a static condition. The evidence that halogen atoms are sometimes positive and sometimes negative and that the oxygen atom of the amine oxides is partly positive also points to a transfer of electrons which takes place in some other manner than that supposed by Irving Langmuir in his interpretation of the hypothesis of G. N. Lewis.

NOTES OF THE EXPOSITION

Laboratory apparatus companies at the Exposition told of a big rush of orders which is being received just now from those who are getting new laboratories and college equipment in order. Apparently every one is stocking up in order to fill the gaps which could not be cared for during the war period. Delays in deliveries due to this congestion of business are still further aggravated in some cases by strikes in the plants where glassware and other important fundamental materials are produced.

A very satisfactory spirit of service was made clear by the exhibits of laboratory equipment. This found a most cordial welcome among executives who have to plan equipment for research laboratories. The desire of the companies was clear, to build equipment well suited to the needs of the user and not to urge the user to fit his needs to apparatus listed in the catalogue. A real scientific attention to apparatus construction is at the root of this advance.

Several Canadian companies and the *Canadian Chemical Journal* were present, renewing acquaintances and making new friends among the American visitors. This Journal is taking great pride in announcing itself as recently appointed the official organ of the Canadian Institute of Chemists. Other exhibitors from Canada represented the department of mines and waterpower, the Toronto harbor commissioners and the Shawinigan electrochemical developments.



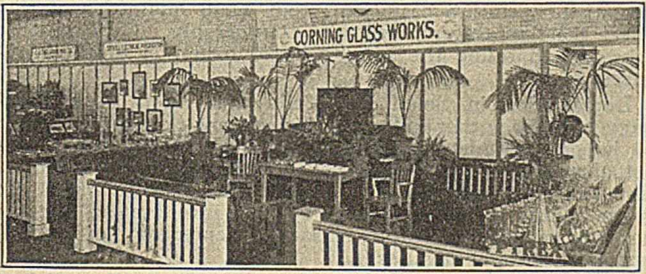
It was clear that the moving exhibits were the ones that attracted most attention. Apparatus, large and small, was featured by this method, including devices for flotation, airconditioning, electrostatic and electromagnetic separation, pulverizing, grinding, separation by sedimentation, and many others. Compressors, vacuum pumps and other types of machinery, even including sprinkler-heads and fire extinguishers were demonstrated in this way. An interesting side-light on this sort of exhibits was shown by a statement from one of the firms which found it necessary to have two pipe-fitters assist on Sunday, the day before the opening. The bill for their services was only eighty dollars. However, it appeared that even these large costs were justified by the great increase in attention to this sort of display.

The coking of Illinois coal and production of by-products were demonstrated by one company, which showed samples and gave the results of official tests made recently at one of their plants by the United States Bureau of Standards and Bureau of Mines. This emphasis on the prospect of extending the coking of mid-continent coal attracted much attention. If it proves commercially feasible to do this, it will mean much for our industries of this field.

This by-product company also showed publicly for the first time a new sort of oven construction, using a double set of triangular flues. Some of the structural advantages were explained and it was pointed out that this system gives each oven a greater independence from the influence of the ovens adjoining it in a battery.

Porcelain exhibitors, including "Coors," "Guernsey," and "Ohio," were on the job, demonstrating that American-made ware is O. K. Great emphasis on American-made glassware was also given by exhibits from practically all firms in this field.

The Chicago Section of the AMERICAN CHEMICAL SOCIETY had a booth where they acted as hosts under the able leadership of the chairman of this section, Dr. L. V. Redman. The monthly bulletin of this section served as the first available guide to all features of the show. The cordial welcome afforded by this section was supplemented by that of the various technical periodicals where information offices were maintained.



The further adaptation by Spitzglass of the multiple contact for a pressure gauge enabled the Republic Flow Meters Company to demonstrate their devices as applied to gas, using the same principle which they have employed in their steam meters. This electrical recorder will serve with either an orifice or a pitot-type flow meter and the makers claim greatly increased convenience and accuracy with greatly decreased cost of installation for large capacities.

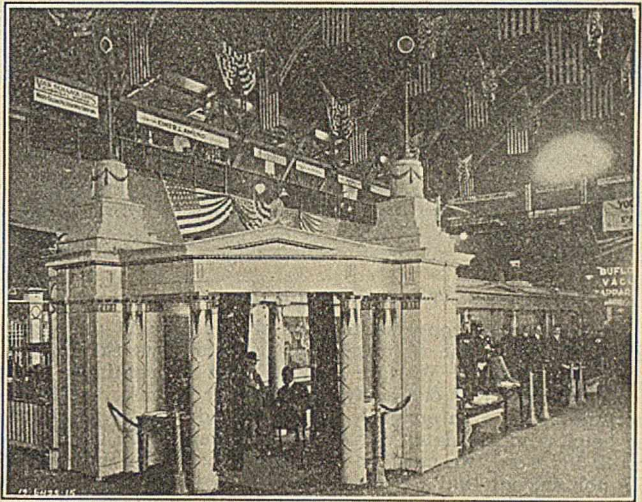
Governor Lowden of Illinois was called to Washington to testify before the Congressional committee on budget reform, so that they might have knowledge as to the results under the Illinois system. This made it impossible for the Governor to make the opening address at the Exposition. Dr. Charles H. Herty, editor of THIS JOURNAL, was also prevented from attending to participate as one of the speakers in the opening meeting by his absence in Europe.

That the Chairman of the Advisory Board of the Exposition had not forgotten this occasion was evidenced by a cablegram from him, dated from Paris on the opening day of the Exposition, as follows:

"All together for American independence; best wishes for successful exposition; regret exceedingly necessarily absent.—HERTY."

The Semet-Solvay Company and the Solvay Process Company departed from the usual line of products that one thinks of in connection with by-product coking and emphasized by a model farm some of the uses of chemical products in which they are interested.

The Chemical Warfare Service with smoke, smells and noise was very much in evidence. One would think that the very realistic gas alarms must have made all overseas veterans nervous because they did not have a gas mask within reach. The equipment shown by this branch of the service included samples of masks at all stages of production and a variety of gas, smoke and chemical shell and other material of ordnance which are specially applicable for trench warfare of this sort.



One of the speakers at the opening session made the surprising statement that in the entire United States there are only as many chemists as there are lawyers in the city of Chicago alone. If this is true one can well realize that we really need to have the very largest registration of students who expect to take chemistry in our colleges and universities, which is being experienced this year. Incidentally this is giving the faculties of every institution a serious problem, as not nearly enough men are available for instructors and assistants.

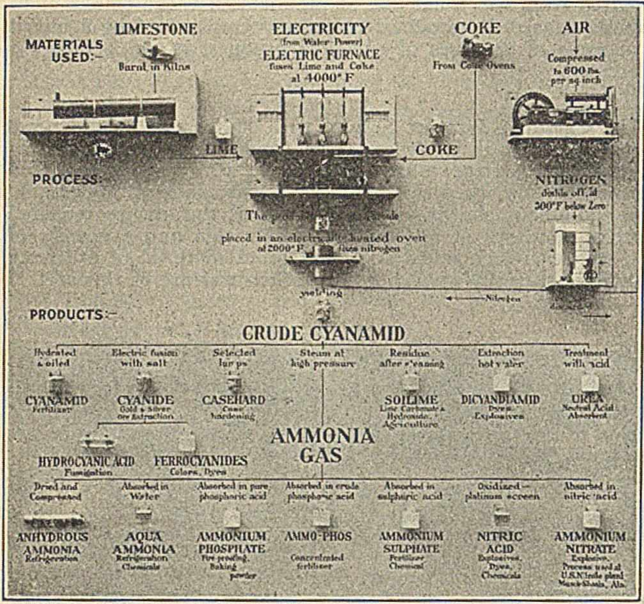
At least two professors of industrial chemistry took advantage of the Exposition to bring their classes of students to Chicago for a special course in connection with the Exposition and the industries which were open during this week. Prof. H. C. Peffer, of Purdue University, and Prof. E. P. Harding, of Minnesota, were thus very busy with their classes.

Four exhibitors, working jointly at a vantage point in the center of the main exposition hall, demonstrated that real art is one of the most effective means of presenting technical material. To eliminate the gaudy and substitute the artistic found increased appreciation at the Exposition.

One of the features which made the Exposition a great success to the firms represented was the fact that many buyers were present prepared to make important decisions regarding purchases.

The use of miniature apparatus representing plant equipment added greatly to the effectiveness of such displays as those for stoneware to be used in nitric acid plants, engineering equipment displays, etc.

A striking development of our war work was evidenced in the many suggestions which were presented for the peace-time use of equipment which had been developed for military uses or munition production. For example, the use of a nitrating kettle for the blending of oils was suggested in order that great saving of time should be accomplished and the influence of oxidation and darkening of the oil eliminated.



The Cyanamide Industry

One subject of conversation that always brought out strong expression from the chemists in attendance was the thought that the Chemical Warfare Service must be continued as a separate branch of our army for complete success in this important field. One eminent chemist stated "If we are not to be helpless in any later war against an enemy who may easily break his word, we must be prepared fully in this particular." He pointed out that we must study at all times the art of gas offense in order to be ready to protect our own troops against this means of attack. In other words offense studies are an essential prerequisite to defense studies.

That a glass blower who is skilled at his trade is an effective attraction was evident from the crowded aisles about one of the booths where a workman was engaged in the production of blown glassware. Similar demonstrations of the method of preparation of cups, cigarette holders and other materials made from redmanol and bakelite attracted great attention.

It was with great regret that the members of the Electrochemical Society and Mining Engineering Institute learned that the trip to Gary could not be held because of the strike.

The industrial aspect of the chemist's problems was emphasized by numerous exhibits of safety devices including fire extinguishers, sprinkler heads, dust respirators, masks, resuscitation devices, special material for treating burns, etc. On the last day of the Exposition a symposium on safety methods particularly applicable in this field was conducted as a part of the general program.

The professional chemical fraternity, Alpha Chi Sigma, had a registration desk at the Chicago Section of the American Chemical Society. It was found that over two hundred members of this organization were in attendance and more than half of these joined in the dinner party on one of the evenings during the exposition week. Similar social functions innumerable were held by organizations in which chemists predominated.

One of the interesting features was the extensive use of the popular press, to which large numbers of "stories" were regularly issued by the publicity department of the Exposition.

Numerous distinguished visitors were present, including a large delegation from the Swiss Industrial Commission, which arranged its itinerary so that it would be present in Chicago during the week of the Chemical Exposition. Charles M. Schwab, of the Bethlehem Steel Corporation, and numerous other distinguished individuals also found the occasion of sufficient interest to give hours of their time to viewing the exhibits.

An unusual number of technical and trade journals were represented at the booths of the exposition.

A most amazing collection of motion picture films on technical subjects was shown at various times during the week. Every evening it was planned to have such a display, films of related sort being given on the same evening so that the visitors might attend exhibitions which were of most interest to them and gain all of the important information that was available from this effective means of publicity.

The exhibitors have learned how to exhibit.
War has been a great catalyst of chemical progress.
The buyers were there; the Exposition was a success.
The exhibits—a super-saturated solution of good material which is precipitating in every impressionable mind.

MEETINGS OF SCIENTIFIC ORGANIZATIONS

AMERICAN ELECTROCHEMICAL SOCIETY

In connection with the Chemical Exposition, the American Electrochemical Society held its 36th General Meeting on September 23 to 26, inclusive. Many of the sessions were held jointly with the American Institute of Mining and Metallurgical Engineers, especially the sessions on iron and steel, ferrous and nonferrous metallurgy, and pyrometry. The many attractions led to a fine attendance and great interest in the society reports.

At the first session the committee report on a standard method for recording the potential data in electrochemical literature led to a spirited debate. The majority report of the committee was finally adopted and there is now to be a standard practice in the nomenclature (as to plus and minus signs) of the publications of this society.

Some of the numerous papers presented at the meetings, including those from this society for joint sessions, were as follows:

Manganin. M. A. Hunter and J. W. Bacon. The authors measure the effect of small variations in the percentages of manganese, nickel and iron on the electrical resistivity and on the temperature coefficient of resistivity. They also studied its thermo-electromotive force against copper. They conclude that small variations in manganese affect the resistivity but not its temperature coefficient; that small quantities of iron affect the temperature coefficient considerably. Care must be taken in annealing the wire to avoid oxidation of the manganese in it.

Depreciation in Small Dry Cells with Age. A. J. Helfrecht. The author endeavors to show how closely the method of judging cell deterioration, called "flash test," approaches actual measurements of capacity through discharging the cells. Comparative curves for the different sizes of cells tested are given. From the data gained by this investigation a table has been compiled indicating reasonable depreciation of the four important sizes of small cells.

The Effect of Amalgamation upon the Single Potential of Aluminum. Louis Kahlenberg and John A. Montgomery. Measuring the single potential of aluminum in a ⅓ molar solution of aluminum chloride at room temperature, by means of the calomel electrode, the writers obtained much higher values with amalgamated than with unamalgamated aluminum, due to the removal of the coat of resistant oxide by the mercury. They showed also that the measurements were actually the single potentials of the aluminum and not those of an aluminum amalgam.

The Effect of Amalgamation upon the Single Potentials of the Binary Alloys of Aluminum with Copper, Zinc, and Nickel. Louis Kahlenberg and John A. Montgomery. While an insufficient number of alloys have been prepared to draw any conclusions with regard to the form of the single potential curve for the entire series, nevertheless, from the data it is quite evident that by amalgamation the initial potentials of the alloys which contain less than 35 per cent of nickel are much higher than the potentials which are measured upon the unamalgamated specimens. Just as in the aluminum-copper series, there is a break in the curve for the readings made upon the amalgamated alloys of aluminum and nickel. The minimum occurs at 7 per cent of nickel, while the eutectic, according to Gwyer, corresponds to 6.5 per cent of nickel. It will be recalled that the break in the curve representing the readings taken upon the amalgamated alloys of the aluminum-copper series also occurred at about the eutectic for that series. The potential of the 56 per cent nickel alloy of aluminum was not obtained, since it was not in a suitable condition to warrant any measurements being made.

The Activation of Carbon. N. K. Chaney. The war has brought into existence, as an article of commerce, a new product known as "activated carbon." Originated as a means of defense against toxic gases in warfare this material is rapidly finding industrial applications, the extent and novelty of which are not as yet generally appreciated. The development of activated carbon represents something more than a mere improvement in older forms of adsorptive carbon, or in older processes. It stands for a new viewpoint as to the general nature of so-called amorphous carbon.

Electric Furnace for Experimental Work. F. A. J. FitzGerald and Grant C. Moyer. The authors present description and detail drawings of a furnace built up to heat the charge in the crucible by radiation from the arc, which they usually operate at 50 volts with 500 to 1000 amperes. They state: "While there is nothing original in the general principles of the furnace it is believed that the detail design may be found as useful by others as it has by us, on account of its being so cheap and easy to construct."

A Square Deal for the Electric Furnace. H. G. Weidenthal. A polemic defending the electric furnace for steel-making against prejudices of the trade. The user is urged to acquaint himself thoroughly with electric furnace practice and furnish the best that can be produced by the electric furnace. Thus "he will do justice to himself and his business, and at the same time give the electric furnace a square deal."

Radiant Resistor Furnace. F. A. J. FitzGerald. The author describes a radiant resistor furnace for the distillation of low-grade or scrap zinc, which was built and operated at the FitzGerald Laboratories and produced several tons of refined zinc. The best results were obtained with a current of approximately 845 amperes at 65 volts or 55 kilowatts. With this power the output was about 50 kilograms refined zinc per hour.

Electric Heat in the Typewriter Industry. A. M. Clark. An electrically heated oven is described for baking japan on various parts of typewriters. The method of use is explained and comparative tables show the better economy and larger capacity of the electrically heated oven, compared with gas or oil heated ovens.

Some Problems in Contact Catalysis. Wilder D. Bancroft. The author states: "My attention has been drawn recently to several cases in which a reaction comes apparently to a standstill although no equilibrium has been reached. The experimental data are not as satisfactory as I should like; but I think that the results should be put on record for what they are worth."

Factors Governing the Structure of Electro-Deposited Metals. William Blum. Of the suggested generalizations in this field the most comprehensive are those contained in Bancroft's so-called "axioms of electroplating" first offered in 1904 and reiterated in 1913. One reason for the lack of discussion or application of these axioms by electroplaters is the fact, pointed out by Mr. G. B. Hogaboom in 1913, that few platers could even understand, much less employ them. In order, therefore, to translate these axioms into platers' language and to illustrate their application to electroplating, a number of simple experiments were recently conducted at the Bureau of Standards, the results of which were presented in an informal report to the American Electroplaters' Society. Even though the experiments were primarily pedagogical and in no sense conclusive or exhaustive, it is believed that the results may be of some interest to the Electrochemical Society and may serve to invite discussion of these axioms or other principles of electrodeposition. If some such principles can be definitely established and accepted as a working basis for research in this field, an economy of time and effort will be effected for both the investigator and the commercial operator. The author concludes: "Experiments have shown that Bancroft's 'axioms of electroplating' are applicable over a wide range of conditions and with a variety of metals. They may, therefore, serve as a valuable guide in plating research and in practical plating operations."

Lead Plating from Fluoborate Solutions. W. Blum, F. J. Liscomb, Zalia Jenks and W. E. Bailey. Comparison of the fluosilicate and fluoborate baths showed that the fluoborate possessed certain advantages, among which were: (1) It may be prepared by any operator from chemicals easily obtainable; (2) it may be used to plate directly upon steel, whereas in the fluosilicate solution the steel must be first copper plated or receive other special treatment; (3) the fluoborate solution is less readily decomposed and produces less sludge than does the fluosilicate; and (4) the deposits from the fluoborate solutions are more dense and more nearly impervious than those obtained under similar conditions from the fluosilicate solutions. The work as described in this paper represents therefore the result of a large amount of preliminary work and of a comparatively few well-defined experiments upon the effects of changes in the composition, concentration and current density, together with some data upon methods of testing and analyzing such solutions. No attempt was made to secure high accuracy in the various measurements, since only the more pronounced effects of the different variables were being investigated. While it is not possible to predict at this time the future scope or applications of lead plating, it seems desirable to place on record the results of these experiments, which it is not practicable to continue at this time. It is finally concluded, "lead plating is a practical operation, which can be conducted by an experienced plater with the usual facilities. There is a considerable field for its future application."

The Penetration of Iron by Hydrogen. T. S. Fuller. The results are given of experiments showing the effect of various conditions on the penetration of iron by nascent hydrogen at temperatures from 20° to 100° C. Hydrogen was generated on the outside of an iron tube by immersing the tube in a solution, and the volume of gas penetrating to the inside of the tube was measured. The rate was greater for a unit immersed without electrical connections than when the unit was used as a cathode, but in the latter case the greater the current the greater the penetration. The rate also increases with the temperature. Copper is not penetrated, but a coating of tin on the iron increases the rate. The effects of other conditions are shown.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS

PYROMETRY SYMPOSIUM

Under the auspices of the American Institute of Mining and Metallurgical Engineers there was held on Thursday and Friday an extensive symposium on pyrometry. This was the result of the joint efforts of the National Research Council Committee on Pyrometry and the Divisions of Heat and Metallurgy of the National Bureau of Standards. Dr. G. K. Burgess, chief of the Metallurgical Division of the Bureau of Standards, presided, and Paul D. Foote, pyrometer specialist of the Bureau, was secretary of the sessions.

This symposium, including as it did, fifty-five papers on all phases of the general subject, was the most impressive symposium on this or similar subjects ever held. One of the reasons for its success was the splendid spirit of coöperation which the promoters found in every quarter when developing papers for the occasion.

The symposium was opened by a series of papers discussing the fundamental concepts of temperature and of methods for temperature measurement. A discussion of the standard scale of temperature and the thermodynamic scale in its relation to radiation and optical pyrometry was included.

A series of papers from representatives of the Bureau of Standards discussed fundamental methods and apparatus. This was followed by several reports from representatives of the Nela Laboratories of Cleveland, who discussed particularly optical methods and the status of our knowledge of means for controlling temperatures.

Representatives of several companies making pyrometric equipment made clear the status of the art of pyrometer construction. This was also the occasion for considerable attention to the subject of porcelain and other materials for pyrometer protection tubes. It was made clear that it was still practically impossible to get wholly satisfactory material for tubes to be used at temperatures of 1400° C. and above. Permeability to gases, melting point, and chemical characteristics, all came in for their share of the discussion.

The industrial application of pyrometers in glass-furnace control aroused one of the most interesting phases of the discussion. It is clearly evident that in this, as in many other cases, the technique of applying pyrometers is not yet fully developed. The application of pyrometry in cement burning, the ceramic industries, the manufacture of clay ware, the production of many other industrial materials showed the practical applications of this equipment. The teaching of pyrometry also came in for its deserved share of attention.

It is planned that the series of papers and the discussion which they aroused will be printed by the American Institute of Mining and Metallurgical Engineers as a resumé of this important series of meetings. That the subject is worthy of attention is clearly evident from the unexpectedly large attendance at sessions which more than taxed the capacity of the large meeting place. That a report of this proceeding will find a place as a technical classic in our libraries is certain.

TECHNICAL ASSOCIATION OF THE PAPER AND PULP INDUSTRY

The fall meeting of the Technical Association of the Paper and Pulp Industry was held in Chicago on September 24 to 27, in connection with the Fifth National Chemical Exposition. This proved to be one of the best attended and most successful of the quarterly sessions of the society. Many of the exhibits at the Exposition and several attractive side trips added greatly to the enthusiasm and value.

Especially attractive features were the luncheon and afternoon spent at Sears, Roebuck and Company, with visits to the paper mill, wallpaper plant, and other departments of special interest to the membership. The whole day Friday was spent in the visit of the society to the Forest Products Laboratories of the Department of Agriculture, located in Madison, Wis.

The report of the committee on soda pulp consisted of a review of the principles involved in the washing of unbleached soda pulp, by the chairman of the committee, M. L. Griffin. After discussing the advantages of deep and shallow tank washing, it was concluded as follows:

> Thus we observe that there is a medium point between these extremes, depending upon local circumstances where the best results may be obtained. By all of these processes, large amounts of heat are lost and the washing requires large volumes of hot water. The movement of the pulp is intermittent, thus necessitating considerable tank storage capacity at different stages of the process.
>
> Opposed to this old-time practice, I desire to present an entirely new view of washing soda pulp which I believe may become practical, and which I have referred to earlier in this paper.
>
> With the rapid strides made during the last few years in mechanical continuous filtration, I believe it is quite within the range of possibility to filter and wash soda pulp with greater economy. The matter is so interesting to builders of such filters that I hope they will participate in the discussion of this prospect.

A report of the committee on testing methods gave a review of the present accepted practice for examinations through chemical, mechanical, and microscopic methods. Brief reports were presented on sulfite pulp and sulfate pulp, also. Another project which developed considerable discussion was the plan for publication of material to serve in vocational educational work. The medium to be used for this was an important consideration.

A paper by Otto Kress of the Forest Products Laboratory covered the question "Deterioration of Wood and Wood Pulp Due to Infection by Fungi." Suggestions for the control and the prevention of losses from this source were presented, including the possibilities of use of disinfecting fluids such as a solution of ammonium fluoride. This paper and the report on soda pulp both elicited lively discussions.

AMERICAN CERAMIC SOCIETY

Wednesday, September 24, was spoken of as Ceramic Day, for the American Ceramic Society held its meetings at this time. The program for the morning was opened by Charles F. Binns' paper entitled "The American Ceramic Society—Past, Present and Future."

Alexander Silverman, presenting data in connection with his paper entitled "Buy on Analysis," made a very effective argument by contrasting the composition of materials from different sources. His paper dealt with the variations in composition of soda ash, pearl ash, limestone, quick lime, burnt lime, sand, litharge, nitre, salt cake, zinc oxide, alumina, china clay, feldspar, fluorspar, cryolite, and other minerals and chemicals used in the manufacture of glass. It illustrated the wide range of possibilities in composition and emphasized the necessity for purchasing one kind of material for a given manufacturing purpose. The author pointed out that there is not so much danger in the difference of composition as in substituting a material of one composition for that of another formerly employed in glass making at a given factory without making necessary corrections. The paper further emphasized the importance of the density of material such as soda ash and the mechanical analysis of sand, calling attention to variations in grain size which might produce different results in glass manufacture. The paper entitled "Superior Refractories," by Ross C. Purdy, discussed the various fused refractories, particularly those like silicon carbide and alundum, which are, in general, electric-furnace products. The history and the present status of artistic pottery was described by Frederick H. Rhead, who delivered a paper entitled "The Making of Pottery."

One of the most interesting bases of classification of optical glass which has been proposed was presented by Robert J. Montgomery in his article entitled "General Types of Optical Glass." He presented charts, in which he plotted index of refraction in comparison with the dispersion of the glass. Using this basis of classification he divided the field into 23 parts, representing the 23 types of glass which he named. Of these types 12 are now being successfully made in this country.

The article by Douglas F. Stevens entitled "Brick and Tile" referred particularly to the application of these materials in the construction of industrial chemical equipment. The article expected from Dr. A. V. Bleininger on the application of scientific methods in ceramic research was not given because of the absence of the author on account of illness. As a substitute, Dr. E. W. Washburn spoke on "Some Aspects of Science and Research as Applied in Glass Manufacture." His remarks covered the following points: With the development of methods of producing, controlling and measuring high temperatures in the laboratory our knowledge of the chemistry and physics of high temperature processes has steadily increased and applications of that knowledge have naturally followed. The stimulus of the war has aided greatly in bringing together the practical man of the factory and the scientist of the laboratory. But in glass making we know *how* to-day much better than we know *why*. Progress demands that we know why. In industrial laboratories the work to be done may be roughly classified under three headings: (1) routine testing of raw materials and products and similar control work; (2) works problems including the curing of troubles and the improvement of processes and products; (3) fundamental research to find out the *why* of the operations or to secure quantitative scientific data covering materials, processes and products. In the glass industry almost all of the fundamental research work remains to be done. For example, very little is known of the relations between (1) viscosity and (2) temperature and composition, although viscosity has long been recognized as of great importance in making and working glass. Surface tension and vapor pressure and even density have scarcely been studied at all. Of the reactions and compounds we know almost nothing. The nature of gases remaining in solution is almost unknown, as well as their effect, if any, on the properties of the glass. Many unanswered questions are referred to, including relations between composition and properties, cause of greenish color resulting from substituting soda for potash, the condition of copper in glass, the cause of pink color from manganese, and red in chrome pink, and the function of arsenic. There are three types of laboratories to carry out such researches: (1) industrial, (2) government or research foundations, and (3) university. The endowment of research professorships in glass would have a very stimulating effect.

Another article not on the regular program was presented by A. Malinovszky, who spoke regarding "Silimanite Brick."

"The Manufacture of Optical Glass" was discussed in an illustrated lecture by J. C. Hostetter. This article reviewed the war work in the various plants where optical glass was being produced and discussed many of the difficult problems which were solved so successfully by the chemists working in this field.

Special interest was given to the occasion of these meetings by the presence of Mr. Connolly, Mr. W. M. Travers, president of the English Ceramic Society, and Mr. W. E. S. Turner, secretary of the British Society of Glass Technology. These three foreign visitors added to the program by interesting contributions to the discussion of the several papers.

The technical sessions of the society were very effectively supplemented by a special series of motion picture films and visits to the exposition booths, many of which contained material of great interest to the membership of this organization. Several social functions were also held.

AMERICAN STEEL TREATERS' SOCIETY

The American Steel Treaters' Society was organized in September 1918 and has for its purpose the increased efficiency of all of those interested in the heat treatment of steel. The society is entirely educational in its purpose, and is not for profit. Consequently, the success it has attained since its organization reflects the wonderful field for a society serving as a clearinghouse and a medium of exchange for new ideas, new methods, and equipment in this line.

The first annual convention and exhibit of this society was held at the Seventh Regiment Armory, Chicago, during exposition week. The program included over 70 reports and technical papers.

SCIENTIFIC SOCIETIES

FIFTY-EIGHTH MEETING AMERICAN CHEMICAL SOCIETY, PHILADELPHIA, PA., SEPTEMBER 2-6, 1919

PROGRAM OF PAPERS

GENERAL SESSION

Address of Welcome. Joseph S. McLaughlin, Director of Supplies of City of Philadelphia.
Response. William H. Nichols, President, American Chemical Society.
Chemistry in Warfare. Newton D. Baker, Secretary of War.
Chemistry and the Navy. Rear Admiral Ralph Earle, Chief, Bureau of Ordnance, U. S. Navy.
President's Address—Research and Application. William H. Nichols.
Some Problems and Methods in Agricultural Research. H. J. Wheeler.
Some Physiological Effects Produced by Radiating Definite Regions within a Single Cell. W. V. Bovie.
Stream Pollution and Its Relation to the Chemical Industries. Earle B. Phelps.
The Building of Atoms and the Periodic Systems. (Lantern.) W. D. Harkins.
The Chemical Laboratory as a Publicity Factor. (Lantern.) Robert P. Fischelis.

AGRICULTURAL AND FOOD CHEMISTRY DIVISION

W. D. Richardson, *Chairman* T. J. Bryan, *Secretary*

1. What was the Diet of Aboriginal Man? (Lantern.) W. D. Richardson.
2. On the Constitution of Butterfat. (Lantern.) W. D. Richardson.
3. Some Experiments on Simple Dietaries. (Lantern.) W. D. Richardson.
4. Influence of Segregation upon the Composition of Sugar Products. C. A. Browne.
5. The Hygroscopic Capacity of Certain Food Constituents. C. A. Browne.
6. The Relative Importance of Some Coloring Matters in Sugar Cane Juices and Syrups. F. W. Zerban.
7. Nutrition Experiments with Low-Cost Protein Diets with Reference to the Utilization of Peanut and Soy Bean Flours. Carl O. Johns, A. J. Finks and Mabel S. Paul.
8. The Amount and Distribution of Iron in the Corn Plant. G. N. Hoffer, R. H. Carr and I. L. Baldwin.
9. The Effect of Concentration on the Deteriorative Activity of Mold Spores in Sugar. Nicholas Kopeloff, S. Byall and Lillian Kopeloff.
10. Respiration of Cranberries. Fred W. Morse.
11. Chemical Change in Cranberries during Storage. Fred W. Morse.
12. The Cause of Deterioration and Spoiling of Corn and Corn Meal. J. S. McHargue.
13. Water Soluble Manganese of Soil. W. O. Robinson.
14. The Composition of Ultra Clay. W. O. Robinson.
15. Composition of Soil Extract. W. H. Fry.
16. Melezitose in Honey. Edgar T. Wherry.
17. Milk with High Apparent Acidity. Frank E. Rice.
18. Effects of Sulfur on Manure Phosphate Composts. (By title.) W. E. Tottingham.
19. The Quantities of Preservatives Necessary to Inhibit and Prevent Alcoholic Fermentation and the Growth of Molds. (By title.) Margaret C. Perry and G. D. Beal.
20. Shark Meat as an Edible Product. Allen Rogers.

BIOLOGICAL CHEMISTRY DIVISION

I. K. Phelps, *Chairman* R. A. Gortner, *Secretary*

1. Chemotherapy of Organic Arsenicals. C. N. Meyers.
2. The Chemical Composition of Arsphenamine (Salvarsan). G. W. Raiziss.
3. A Comparative Study of the Trypanocidal Activity of Arsphenamine and Neoarsphenamine. J. F. Schamberg, J. A. Kolmer and G. W. Raiziss.
4. Chemotherapeutic Studies with Ethylhydrocuprein and Mercurophen in Experimental Pneumococcus Meningitis of Rabbits. J. A. Kolmer and Goro Idzumi.
5. Coördination of the Principles of Chemotherapy with the Laws of Immunity and the Successful Application in the Treatment of Tuberculosis. Benjamin S. Paschall.
6. The Chlorinated Antiseptics (Chloramine-T and Dichloramine-T). I. F. Harris.
7. An Agent for the Destruction of Vermin—Method of Application. A. A. Epstein.
8. An Iodine Preparation for Intravenous and Intraspinous Use—Its Therapeutic Action. A. A. Epstein.
9. The Local Anaesthetic and Other Pharmacological Actions of Saligenin and Other Phenolic Alcohols. A. D. Hirschfelder, A. Lundholm, H. Norrgard and J. Hultkrans.
10. Changes in the Irritability of Intestinal Loops under the Influence of Various Drugs which Inhibit the Parasympathetic Nervous System. A. D. Hirschfelder, H. Lundholm, A. Norrgard and J. Hultkraus.
11. Effect of Fever on the Toxicity of Digitalis in Frogs and Mammals. A. D. Hirschfelder, J. Bicek, F. J. Kucera and W. Hanson.
12. The Toxicity of Tobacco Smoke from Cigars, Cigarettes and Pipe Tobacco. A. D. Hirschfelder, A. E. Lange and A. C. Feaman.
13. Some Applications of Protein Chemistry to Medicine and Pharmacy. I. F. Harris.
14. Action of Chloretone on Animal Tissue. T. B. Aldrich.
15. The Outlook for Chemotherapy in the Chemical Industry of America. C. L. Alsberg.
16. Blue Eyes. W. D. Bancroft.
17. Colloidal Reactions Fundamental to Growth. D. T. MacDougal.
18. The Antiscorbutic Value of the Banana. (By title.) H. B. Lewis.
19. A Study of Various Culture Media, Especially with Reference to Increasing Their Buffer Effect and Adjusting Their PH Values. (Lantern.) M. R. Meacham, J. J. Hopfield and S. F. Acree.
20. The Cause of and Remedy for Certain Inaccuracies in Hausmann's Nitrogen Distribution Method. (Lantern.) S. L. Jodidi.
21. The Antiscorbutic Properties of Raw Lean Beef. (Lantern.) R. A. Dutcher, E. M. Pierson and A. Biester.
22. Preliminary Observations on the Influence of the Diet of the Cow on the Antiscorbutic and Growth-Promoting Properties of Milk. (Lantern) R. A. Dutcher, E. M. Pierson and A. Biester.
23. Rhubarb as an Antiscorbutic. (Lantern.) E. M. Pierson and R. A. Dutcher.
24. The Function of Vitamines in the Metabolism of *Sclerotinia Cinerea*. (By title.) J. J. Willaman.
25. The Preparation of a Stable Vitamine Product and Its Value in Nutrition. H. E. Dubin.
26. Chemical Isolation of Vitamines. C. N. Myers and V. Voegtlin.
27. The Vitamine Content of Wheat Flour. C. O. Johns, A. J. Finks and M. S. Paul.

28. The Relation of Plant Carotinoids to Growth, Fecundity and Reproduction in Fowls. (By title.) L. S. Palmer and H. L. Kempster.
29. The Physiological Relation between Fecundity and the Natural Yellow Pigmentation of Certain Breeds of Fowls. (By title.) L. S. Palmer and H. L. Kempster.
30. The Influence of Specific Feeds and Certain Pigments on the Color of the Egg Yolk and the Body Fat of Fowls. (By title.) L. S. Palmer and H. L. Kempster.
31. The Relation of the Natural Enzymes of Butter to the Production of "Tallowness" through the Agency of Copper Salts. (By title.) L. S. Palmer and W. B. Combs.
32. The Nutritive Value of Commercial Corn Gluten. C. O. Johns, A. J. Finks and M. S. Paul.
33. The Effect of Calcium on the Composition of the Eggs and Carcass of the Laying Hen. G. D. Buckner and J. H. Martin.
34. Protein Requirement in the Maintenance Metabolism of Man. H. C. Sherman.
35. The Development of *Tribolium Confusium* in Certain Foods. R. N. Chapman.
36. The Influence of Quinine on Uric Acid Excretion in Man. (By title.) H. B. Lewis and W. L. McClure.
37. The Uric Acid Content of Normal Human Saliva. (By title.) H. B. Lewis and W. S. Griffith.
38. Studies on the Chemical Composition of the Brain of Normal and Ataxic Pigeons. M. L. Koch and O. Riddle.
39. A Comparison of the Distribution of Various Chemical Groups in Parts of the Human and Pigeon Brain. O. Riddle and M. L. Koch.
40. Calorimetric Determinations of the Energy in Yolk-Protein and Yolk-Fat of Doves and Pigeons. O. Riddle.
41. Some Properties of the Placental Hormone. P. M. Giesy.
42. The Preparation of Fatty Acid Esters of Cholesterol. G. D. Beal and J. B. Brown.
43. Comparative Hydrolysis of Fibrin in the Presence of Various Aldehydes. G. E. Hohn and R. A. Gortner.
44. The Preparation of Cholesterol in Quantity. P. M. Giesy.
45. The Influence of Aspartic Acid and Asparagin upon the Enzymic Hydrolysis of Starch. H. C. Sherman and Florence Walker.
46. An Improved Technic for Measuring Lipase Activity in Plant or Animal Extracts or Tissues. (By title.) Leroy S. Palmer.
47. The Influence of Various Antiseptics on the Activity of Lipase. (By title.) L. S. Palmer.
48. The Activity of Phytase as Determined by Increase in Specific Conductivity. (By title.) F. A. Collatz and C. H. Bailey.
49. The Fermentation of Fructose by a Group of Pentose Fermenting Bacteria. W. H. Peterson, E. B. Fred and A. Davenport.
50. Factors Influencing the Invertase Activity of Mould Spores in Sugar. N. Kopeloff and S. Byall.
51. Carbon-Nitrogen Ratio in Relation to Plant Metabolism. (By title.) A. M. Gurjar.
52. Vanillyl Acyl Amides. E. K. Nelson.
53. On a Phenol Produced by Growing Aspergillus Tamari. J. F. Brewster.
54. Climatic Control in Relation to Plant Growth. (By title.) W. E. Tottingham.
55. Studies in the Translocation of Nitrogenous and Carbohydrate Material into the Wheat Kernel. (By title.) G. A. Olson.
56. Physical and Chemical Studies of Wheat Gluten. G. A. Olson and Charles H. Hunt.
57. The Composition of the Oil from the Okra Seed. G. S. Jamieson and W. F. Baughman.
58. The Composition of the Oil from the Seed of the Hubbard Squash. W. F. Baughman and G. S. Jamieson.
59. Notes on the Composition of the Sorghum Plant. J. J. Willaman, R. M. West, D. O. Spriestersbach and G. E. Holm.
60. The Physiology of Germinating Juniperus Seeds. D. A. Pack.
61. The Biochemist on the Hospital Staff. F. S. Hammett.
62. A Spectrographic Study of Certain Biochemical Color Reactions. (By title.) G. L. Wendt and T. Tadokoro.
63. Studies of Wheat Flour Grades. I—Electrical Conductivity of Water Extracts. (By title.) C. H. Bailey and F. A. Collatz.
64. Studies of Wheat Flour Grades. II—Buffer Values of Water Extracts. (By title.) C. H. Bailey and A. Peterson.
65. The Preparation of Certain Monocarboxylic Acids from Sugars. I. K. Phelps and W. T. McGeorge.
66. An Examination of Wisconsin Oil of *Monarda Punctata*. Nellie A. Wakeman.
67. On Hemoglobin: Optical Constants. Wm. H. Welker and Charles S. Williamson.
68. Analysis of a Pleural Fluid from a Case of Chylothoiax. Wm. H. Welker and Charles S. Williamson.
69. Digestibility of Avocado and Certain Other Oils. H. J. Deuel.
70. Digestibility of Whole Wheat Flours, Ground by Various Processes. H. J. Deuel.
71. Studies of Proximate Composition of Cooked Foods. I—Variations in Fat Content of Fried Foods and a Consideration of the Causes of These Variations. M. C. Denton.

INDUSTRIAL CHEMISTS AND CHEMICAL ENGINEERS DIVISION

H. S. Miner, *Chairman* H. E. Howe, *Secretary*

I—Symposium on Refractories

1. The Classification of Refractories. (By title.) G. H. Brown.
2. Work of the Technical Department of the Refractories Manufacturers' Association. R. M. Howe.
3. The Selection of Refractories for Industrial Furnaces. W. F. Rochow.
4. Interesting Facts Concerning Refractories in the Iron and Steel Industry. C. E. Nesbitt and M. L. Bell.
5. Superior Refractories. R. C. Purdy.
6. Refractory Problems in the Gas Industry. W. H. Fulweiler and J. H. Taussig.

II—Symposium on Annual Patent Renewal Fees

The symposium will discuss various features of the proposal that a system of annual patent renewal fees shall be adopted for the United States. There will be verbal or written discussions by: T. H. Anderson, L. H. Baekeland, J. M. Francis, Edwin A. Hill, A. D. Little, John Uri Lloyd, L. V. Redman, R. L. Stinchfield, Elihu Thomson, W. R. Whitney, and others, including members of the Patent and Related Legislation Committee of the American Chemical Society, and members of the Patent Committee of the National Research Council.

III—Papers

1. Incendiaries Used in Modern Warfare. (Lantern.) Capt. A. B. Ray.
2. Gas Masks in the Industries. (Lantern.) A. C. Fieldner.
3. Division of Industrial Research, National Research Council. H. E. Howe.
4. The Value of Cost Accounting in Commercial Laboratories. Wm. W. Caswell.
5. Modern Commercial Explosives. R. L. Hill.
6. Chemical Reagents Received by the Bureau of Chemistry during the War. H. E. Buc.
7. Report on the Production of Synthetic Organic Chemicals in the Research Laboratory of Eastman Kodak Co., 1918 and 1919. C. E. K. Mees.
8. The Use of Crystallizers in Cane Sugar Manufacture. Charles E. Coates.
9. The Centrifugal Method for the Rapid Determination of Potash. L. S. Converse.
10. Comparison of Methods for Determining Ammonium Nitrate. J. T. Grissom.
11. Effect of Chlorides on Nitrometer Determinations of Nitrates. M. T. Sanders.
12. The Oxidation of Methane. Quartz Combustion Apparatus. (Lantern.) F. C. Vibrandt and James R. Withrow.
13. Carbon Black—Its Properties and Uses. (Lantern.) G. St. J. Perrott.
14. Adherent Rust as an Accelerator in the Corrosion of Iron and Steel. (Lantern.) W. D. Richardson.
15. Some Properties of Commercial Silicate of Soda. J. G. Vail.
16. The Leaching of Zinc Chloride from Treated Wood. Ernest Batemann.
17. Tensile Strength of Glue. G. Hopp.
18. A New Illuminator for Microscopes. (Third paper.) A. Silverman.
19. The Stability of Tetryl. C. L. Knowles.
20. The Manufacture of Trinitroxylene. John Marshall.
21. The Preparation of Hexanitro-diphenylamine and Its Use as a Booster for Shell Charges. John Marshall.
22. Composition of Some American Sponges. E. P. Dunnington.
23. Quantitative Determination of Potassium as Bitartrate. Sigmund Waldbott and Fred. W. Weissmann.
24. The Properties of Pyroxylin Plastics. (By title.) R. P. Calvert and J. H. Clewell.
25. The Extraction of Potash Salts from Kelp Charcoal. (By title.) J. W. Turrentine and P. S. Shoaff.
26. "Kelpchar," a New Decolorizing Carbon Prepared as a By-Product in the Extraction of Potash from Kelp. (By title.) J. W. Turrentine, P. S. Shoaff and G. C. Spencer.

ORGANIC CHEMISTRY DIVISION

Lauder W. Jones, *Chairman* H. L. Fisher, *Secretary*

1. Cymene as a Solvent. A. S. Wheeler.
2. The Action of Basic Reagents on Certain Schiff's Bases. A. S. Wheeler and S. C. Smith.
3. Structural Problems of the Aniline Derivatives of Citric Acid. J. R. Bailey and E. B. Brown.
4. The Synthesis of Capric Acid. G. D. Beal and J. B. Brown.
5. The Action of Phosphorus Trichloride on Ketones and Aldehydes. James B. Conant and A. D. MacDonald.
6. Condensation of Acetylene with Benzene and Its Derivatives in the Presence of Aluminum Chloride. Otto W. Cook and Victor J. Chambers.
7. The Structure of Azoxy Compounds. Oliver Kamm and E. E. A. Campbell.
8. The Purification and Some Physical Properties of Some Aliphatic Alcohols. R. F. Brunel.

9. The Limit of Esterification of Certain Aliphatic Alcohols and Acids. R. F. Brunel and Elise Tobin.
10. The Condensation of Isocyanic Acid with Alkyl Schiff Bases and Related Compounds. William J. Hale.
11. The Oscillation Theory of Colors—Hydrazobenzene and Azobenzene. Gerald L. Wendt, Ruth O'Brien and F. W. Sullivan.
12. The Chemistry of the Heptane Solution: I—Introductory Remarks; II—Physical Constants of Heptane. Edward Kremers.
13. The Chemistry of the Heptane Solution: III—Purification of Heptane; IV—Hydrohalogen Solutions of Heptane. D. C. L. Sherk.
14. Report on the Production of Synthetic Organic Chemicals in the Research Laboratory of the Eastman Kodak Company for the Year 1918-9. C. E. K. Mees.
15. Perchlormethylmercaptan. Oregon B. Helfrich and E. Emmet Reid.
16. Butyl Alcohol as Medium for Saponification. A. M. Pardee, B. Hasche and E. Emmet Reid.
17. Halogen-Substituted Phenacyl Bromides as Reagents for the Identification of Acids. W. L. Judefind and E. Emmet Reid.
18. Molecular Rearrangement in the Acylation of Certain Aminophenols. L. Chas. Raiford.
19. A More Nearly Rational System of Units. Elliott Q. Adams.
20. Certain Metallic Derivatives of Hydroxy-Anthraquinones. M. L. Crossley.
21. Pyrogenic Conversion of Phenol to Naphthalene. M. L. Crossley.
22. The Reduction of Dihydroxythymoquinone by Means of Palladium-Hydrogen. Nellie A. Wakeman.
23. Congo Red and Some Similar Diazo Dyes. W. R. Orndorff and F. E. Carruth.
24. Synthesis of Anthracene from Naphthalene. C. W. Colver and W. A. Noyes.
25. Positive Iodine in Derivatives of Acetylene. L. B. Howell and W. A. Noyes.
26. The Attraction between Organic Substances and Water, and the Adsorption of Organic Substances. (Lantern.) W. D. Harkins.
27. Determination of the Viscosity of Pyroxylin Solutions. (By title.) E. F. Higgins and E. C. Pitman.

PHARMACEUTICAL CHEMISTRY DIVISION

F. O. Taylor, *Chairman* George D. Beal, *Secretary*

1. A New Field of Phytochemical Research Opened Up by the Cultivation of Medicinal Plants on a Semi-Economical Scale. Edw. Kremers.
2. Some of the Characteristic Toxic Principles of Western Poisonous Plants. O. A. Beath.
3. A Comparison of Several Methods for Estimating Quinine and Strychnine when Occurring in the Same Solution. A. R. Bliss, Jr.
4. Quantitative Determination of Mercury. Sigmund Waldbott.
5. The U. S. P. Assay of Donovan's Solution. Sigmund Waldbott.
6. The Theory of Emulsion Making. W. D. Bancroft.

After the presentation of the regular papers there will be a Symposium on Research in the Field of Chemistry, similar to the one held at the Buffalo Meeting.

PHYSICAL AND INORGANIC CHEMISTRY DIVISION

W. E. Henderson, *Chairman* W. A. Patrick, *Secretary*

1. The Vapor Pressure of Mercury in the Range 120°-250°. Alan W. C. Menzies.
2. The Vapor Pressure of Tetranitromethane. Alan W. C. Menzies.
3. Production of Hydrochloric Acid from Chlorine and Water. H. D. Gibbs.
4. Mineral Disintegration by Phosgene. Charles Baskerville.
5. The Preparation of Colloidal Gold and Silver by New Reducing Agents. Harry N. Holmes.
6. Phase Rule Studies of the Nitrotoluenes. C. H. Herty, Jr.
7. Compression by Adsorption. William D. Harkins and D. T. Ewing.
8. The Work Done by the Attraction between a Mercury Surface and the Surface of an Organic Substance. W. D. Harkins, E. H. Grafton and D. T. Ewing.
9. The Change of Molecular Kinetic into Molecular Potential Energy. William D. Harkins and L. E. Roberts.
10. The Separation of Yttrium from the Erbium Earths. P. H. McP. Brinton and C. James.
11. A New Method for the Determination of Zirconium. M. M. Smith and C. James.
12. The Effect of Lead upon Thorium Nitrate in Aqueous Solution. Fanny R. M. Hitchcock.
13. An Electrometric Study of the Neutralization of Monocalcium Phosphate. Gerald Wendt, A. H. Clarke and S. M. Weisman.
14. The Existence of an Ozone Form of Hydrogen. Gerald L. Wendt and Rob. S. Landauer.
15. Action of Thiosulfate on Arsenate in Acid Solution. (Lantern.) Geo. Shannon Forbes and O. J. Walker.
16. Specific Heat Determinations with an Adiabatic Calorimeter. (Lantern.) Farrington Daniels and Charles B. Hurd.
17. The Partition of Metallic Radicals between a Salt Phase and an Alloy Phase. (Lantern.) Herbert F. Sill.
18. The Retention of Bromine by Silicic Acid Gel. W. A. Patrick and E. L. Ryerson.
19. Determination of the Viscosity of Pyroxylin Solutions. E. F. Higgins and E. C. Pitman.
20. A Slide Rule for Special Cases. F. C. Blake.
21. Adsorption by Precipitates. II—The Adsorption of Anions by Hydrous Ferric Oxide. Harry B. Weiser and Edmund B. Middleton.
22. The Physical Character of Hydrous Ferric Oxide. Harry B. Weiser.
23. Flame Reactions of Selenium and Tellurium. Harry B. Weiser and Allen Garrison.
24. The Catalyst in the Oxidation of Ammonia. G. A. Perley.
25. Equilibria in the Systems: Carbon Disulfide, Methyl Alcohol and Carbon Disulfide, Ethyl Alcohol. E. C. McKelvy and D. H. Simpson.
26. Notes on the Estimation of Nitrates and Nitrites in Battery Acids. Lily Bell Sefton.
27. A Metal to Glass Joint and Some of Its Applications. E. C. McKelvy and C. S. Taylor.
28. The Fluorides of Cobalt, Nickel, Manganese, and Copper. F. H. Edmister and H. C. Cooper.
29. The Determination of Mercury. H. B. Gordon.
30. The Preparation and Uses of $TiCl_3$ Solution. F. L. English and H. S. Tanner.
31. Contrasting Effects of Sulfates and Chlorides on the Hydrogen Ion Concentration in Acid Solutions. A. W. Thomas and M. E. Baldwin.
32. Chromophor Tautomerism in Indicators. William C. Arsem.

DYE SECTION

Charles L. Reese, *Chairman* R. Norris Shreve, *Secretary*

1. Introductory Remarks. Charles L. Reese.
2. Present Condition of German Dyestuff Plants. T. W. Sill.
3. Review of the Dye Situation. J. Merritt Matthews.
4. The Progress of the American Dye Industry as Shown by the Census of the Tariff Commission. Grinnell Jones.
5. Photosensitizing Dyes. E. Q. Adams.
6. The Color Laboratory of the Bureau of Chemistry. (Lantern.) H. D. Gibbs.
7. Alkali Fusions. (Lantern.) H. D. Gibbs and Max Phillips.
8. The System: Naphthalenephthalic Anhydride. (Lantern.) K. P. Monroe.
9. The Melting Point of Pure Phthalic Anhydride. The System: Phthalic Anhydride-Phthalic Acid. (Lantern.) K. P. Monroe.
10. Benzene Sulfonic Acids. I—Benzene Disulfonic Acid from Benzene Mono Sulfonic Acid. (Lantern.) C. E. Senseman.
11. Notes on Testing Dyed Goods. W. F. Edwards.
12. The Quality of American Dyes. R. S. Lunt.
13. The Application of Dyes. E. W. Pierce.
14. Foreign Dye Patents. R. E. Rose.
15. Some Stones in the Foundations of a Great National Industry. T. H. Norton.
16. Explosibility and Inflammability. Burr Humiston, W. S. Calcott and E. C. Lathrop.
17. The Identification of Dyes. E. F. Hitch.
18. Indicators and Their Application. H. A. Lubs.
19. Vat Dyes. M. L. Crossley.
20. Gentian Violet and Its Selective Bactericidal Action. M. L. Crossley.
21. The Importance of Intensive and Original Research in the Development of the Dye Industry in America. M. L. Crossley.
22. Logwood in Its Relation to the Silk Industry. Emil Lesser and David Wallace.
23. Some Engineering Aspects in the Manufacture of Dyes. (By title.) Clarence K. Simon.
24. Observations on the Estimation of the Strength of Dyes. W. H. Watkins.
25. Application of Physical Chemistry Research on Dyes. E. K. Strachan.
26. Crystallographic Indentification of Five Isocyanines. Edgar T. Wherry.
27. The Dye Situation in the United States and England. (By title.) T. Frusher.

FERTILIZER CHEMISTRY DIVISION

F. B. Carpenter, *Chairman* H. C. Moore, *Secretary*

1. Injurious Effects of Borax in Fertilizers on Crops. B. W. Kilgore.
2. The Conservation of Nitrate of Soda in the Chamber Process for the Manufacture of Sulfuric Acid. Andrew M. Fairlie.
3. Check Meal Work of the Society of Cotton Products Analysts (in Particular Reference to the Moisture and Ammonia Determinations). F. N. Smalley.
4. The Deroode-Perchloric Acid Method for Determining Potash. T. E. Keitt.
5. A Rapid and Accurate Method for Determining Nitrogen in Nitrate of Soda by the Devarda Method, and the Use of the Davisson Scrubber Bulb. C. A. Butt.
6. The Rapid and Accurate Determination of Nitrate, as Ammonia, in Nitrate of Soda by a Modification of the Kjeldahl-Gunning Method *vs.* the Deceptive West Coast or Refraction Method. Correct and Rapid Application of the Modified Kjeldahl-Gunning Method to Mixed Fertilizers Containing Nitrate. H. C. Moore.

7. The Caking of Sulfate of Ammonia and Acid Phosphate Mixtures. C. G. Atwater and J. F. W. Schulze.
8. The Caking of Sulfate of Ammonia. C. G. Atwater and J. F. W. Schulze.
9. The American Potash Industry. R. O. E. Davis.
10. The Relative Availability of Nitrate Nitrogen and Commercial Organic Nitrogen in Cylinder and Field Experiments. A. W. Blair.

RUBBER DIVISION

John B. Tuttle, *Chairman* Arnold H. Smith, *Secretary*

1. Report of Executive Committee.
2. Report of Secretary.
3. Report of Fruit Jar Ring Committee. L. J. Plumb, *Chairman.*
4. Report of Committee on Physical Testing. H. E. Simmons, *Chairman.*
5. A New Method for the Determination of Sulfur in Rubber Mixtures. G. D. Kratz, A. H. Flower and Cole Coolidge.
6. The Extraction of Rubber Goods. S. W. Epstein and B. L. Gonyo.
7. The Theory of Balloon Fabric Protection. John B. Tuttle.
8. The Expansion of Rubber Compounds. C. W. Sanderson.
9. Volume Increase of Compounded Rubber under Strain. H. F. Schippel.
10. The Determination of Celluose in Rubber Goods. S. W. Epstein and R. L. Moore.
11. The Variability of Crude Rubber. John B. Tuttle.
12. Symposium on the Action of Accelerators during Vulcanization. Opened by J. H. Scott.
13. The Action of Certain Organic Accelerators in the Vulcanization of Rubber. G. D. Kratz, A. H. Flower and Cole Coolidge.
14. Reactions of Accelerators during Vulcanization. C. W. Bedford and Winfield Scott.
15. The Effect of Organic Acceleration on the Vulcanization Coefficient. D. F. Cranor.
16. The Effect of Compounding Ingredients on the Physical Properties of Rubber. C. Olin North.
17. Some Methods of Testing the Hardness of Vulcanized Rubber. H. P. Gurney.
18. Symposium on the Testing of Pigments. Opened by Geo. Oenslager. Contributions from M. M. Harrison and M. M. Kahn.
19. The Manufacture and Use of Crimson Antimony. J. M. Bierer.
20. Laboratory Aprons. C. P. Fox.
21. The Value of a Library to the Rubber Laboratory. H. E. Simmons.
22. Research on Zinc Products for the Rubber Industry. P. R. Croll and I. R. Ruby.

WATER, SEWAGE AND SANITATION DIVISION

Robert S. Weston, *Chairman* W. W. Skinner, *Secretary*

1. Determination of Iodide and Bromide in Mineral Waters and Brines. W. F. Baughman and W. W. Skinner.
2. The Determination of Bromide and Iodide in Mineral Waters and Brines. H. H. Willard and C. C. Meloche.
3. A Study of Well Water in a Rural Community. G. O. Higley.
4. The Removal of Colloidal Silicic Acid and Clay from Natural Waters. Otto M. Smith.
5. Field Methods for the Chlorination of Small Amounts of Water. (Lantern.) F. R. Georgia.
6. The Electrostatic Precipitation of Dust in the Sanitary Analysis of Air. J. P. Bill.

AMERICAN CHEMICAL SOCIETY ADVISORY COMMITTEE MINUTES

The Advisory Committee met at the Chemists' Club on Monday, August 18, 1919, with President Nichols and Messrs. Herty, Hesse, and Parsons present. Also, Dr. H. S. Miner was present from Philadelphia to discuss with the Committee questions having to do with the program of the Industrial Division. The question of speakers for the general program was also discussed.

A letter was read from Dr. T. B. Wagner, stating that it would be impossible for him to continue as chairman of the Committee on Foreign Chemical Trade in its Relation to our Merchant Marine, to Coöperate with the U. S. Shipping Board. His resignation was accepted, and Dr. H. S. Miner was made chairman, Dr. Wagner being retained, however, as a member of the Committee.

Several letters were read regarding delegates to the Pharmacopoeial Convention. It was at once evident that the Advisory Committee in appointing delegates had mixed in their minds the credential form received from the Pharmaceutical Association with the request for delegates from the Pharmacopoeial Convention. The Secretary was, accordingly, instructed to bring this to the attention of F. R. Eldred, B. L. Murray and F. O. Taylor and to inform them that the credentials given them were for the Pharmaceutical Association meeting in New York in August and that they consider their appointment as applying to that Association. The Advisory Committee will later advise the President as to the appointment of the three delegates to the 1920 Pharmacopoeial Convention.

A letter was read from Mr. Jos. L. Wheeler, requesting the Society to publish and distribute the lists of selective subjects for chemistry reading which had been prepared by the Committee on Preparation of a List Recommending Chemical Texts for Libraries. The Secretary was instructed to write Mr. Wheeler that while the Society would publish such lists in its *Journal of Industrial and Engineering Chemistry,* nevertheless it could not consistently recommend to the Directors, in view of the large cost involved, that the Society go to the expense of publishing this as a pamphlet and generally circularizing the libraries of the country.

Charles L. Parsons, *Secretary*

Washington, D. C.

DIVISION OF INDUSTRIAL CHEMISTS AND CHEMICAL ENGINEERS

MINUTES OF SESSIONS, 58TH MEETING A. C. S.

The division held one of the largest and most successful meetings in its history, the program as printed in the October issue of This Journal being carried out. The attendance was good to the very last. All the papers on the program were presented, and the two symposiums were attractive. The Division was largely indebted to A. V. Bleininger and E. J. Prindle for their success. At the Patent Fees Symposium held with the Pharmaceutical Division and the Dye Section resolutions supporting the bills already approved by the Advisory Committee regarding the changes in Patent Laws were passed. The membership has already been asked by the Advisory Committee to assist in the passage of these bills.

The following officers were elected:

H. D. Batchelor, *Chairman;* W. H. Walker, *Vice Chairman;* H. E. Howe, *Secretary;* J. G. Vail, Chas. H. Herty, W. F. Hillebrand, Edmond O'Neill, S. W. Parr, Joseph H. James, *Executive Committee.*

H. E. Howe, *Secretary*

DIVISION OF FERTILIZER CHEMISTRY

MINUTES OF BUSINESS SESSION, 58TH MEETING, A. C. S.

The meeting of the Fertilizer Division was called to order Thursday morning, September 4, 1919, in the Bellevue-Stratford Hotel, in accordance with the official program, Chairman F. B. Carpenter presiding. The attendants of the meeting numbered fifty-three.

The minutes of the Cleveland Meeting of this Division were read and approved.

The reports of the following committees were made and accepted:

Committee on Fertilizer Legislation, F. B. Carpenter, *Chairman.*

Committee on Research and Methods of Analysis, Paul Rudnick, *Chairman.*

Committee on Sampling. Word was received from F. S. Lodge, *Chairman,* that no report was ready since there had been no meeting of the A. O. A. C. during the past year.

After the reports of committees, papers were presented, as announced on the official program (see page 987).

A short discussion followed the reading of the papers. The authors of Papers 1, 3 and 4 were unable to be present and their papers were read by the secretary.

The report from the Committee on Fertilizer Legislation by F. B. Carpenter, *Chairman,* indicates the present trend of fertilizer legislation and the unnecessary hardships which some of the proposed legislations would impose on the fertilizer manufacturers. To overcome this situation a uniform fertilizer law has been framed by the Soil Improvement Committee and a committee appointed by the chairman of the National Fertilizer Association which will be presented to the Association of Commissioners of Agriculture in the effort to enlist their coöperation toward uniform legislation in all states.

The report by Paul Rudnick from the Committee on Research and Methods of Analysis states that the committee has before it the following subjects:

Method for Determination of Sulfur in Pyrites—Mr. H. C. Moore has completed his work and has developed a satisfactory method, based on the Allen & Bishop Method, and intended to replace the faulty Lunge method. This will be presented to the Supervisory Committee for approval as soon as possible.

Method for Valuation of Nitrate of Soda—This subject has been taken up by Dr. E. W. Magruder. The purpose of this work is to select or develop a suitable method for the valuation of nitrate of soda for commercial purposes to replace the antiquated, faulty West Coast Refraction method.

Method for the Analysis of Ammonium Sulfate—The purpose of this work is to develop a satisfactory method for the sampling and analysis of commercial ammonium sulfate. It has not been possible to assign this subject up to the present time, but every effort will be made to get it under way as quickly as possible.

This being the regular meeting for the election of officers, a motion was passed authorizing the chairman to appoint a nominating committee to return recommendations for officers for the coming year. The chairman appointed for this committee Messrs. Atwater, Rudnick and Blair, who recommended the following:

Chairman, F. B. Carpenter; *Vice Chairman*, R. N. Brackett; *Secretary*, H. C. Moore; *Executive Committee*, H. J. Wheeler, C. H. Jones, E. W. Magruder, A. J. Patten.

A motion was made and duly passed that the secretary cast the vote of the division for the names as recommended.

As there was no further business, the meeting was adjourned.

H. C. Moore, *Secretary*

NOTES AND CORRESPONDENCE

CHANGE OF ADDRESS
SECRETARY'S OFFICE, A. C. S.

Members should note that the address of the Secretary, Charles L. Parsons, is changed from Box 1505, Washington, D. C., to 1709 G St., N. W., Washington, D. C. The Society has opened new offices at this address. Dr. Parsons has resigned from the Bureau of Mines in order to give more time to Society work. He will also undertake a limited amount of private consulting work, especially in the lines of inorganic chemistry and mineral technology, which he has for the past eight years handled for the Bureau of Mines.

THE DECENNIAL INDEX AS AN AID TO ORGANIC RESEARCH

The final volume of the decennial index to *Chemical Abstracts* will soon be in the hands of subscribers. The two subject volumes form a practically complete index to chemical literature for the years which they cover and the annual indexes for 1917 and succeeding years, being arranged on the same system, may be regarded as supplements to it, bringing it up to date periodically. The object of this note is to call attention to the unique aid which this system of indexes offers in the searching of organic literature.

The naming of the organic compounds according to a *uniform system* and indexing them under the names of *parent compounds* to an extent not hitherto attempted in an index, give the system some of the features of a general handbook of organic compounds, combined with the very great advantage of up-to-dateness. It fills a need, therefore, which even a formula index (much as that is to be desired) could not meet; and it has, in fact, already been used at Ohio State University in manuscript form with gratifying results.

One example may be given: Suppose that someone wishes to look up the literature of the benzotriazoles (azimidobenzenes). At "Benzotriazole" in the decennial index will be found the full names of 115 compounds, arranged in order, with their page references. Of the 25 abstracts in which these compounds are described, only 6 give any indication in the title that would lead to their being indexed under one of the class names given above. Consequently, in the ten annual indexes, prepared in the customary way, only 15 of the 115 compounds would easily be found. The rest are scattered through the vocabulary by reason of the fact that their names have such beginnings as "dinitro-," "phenyl-," etc. Two more abstracts contain so much space on benzotriazoles that they should have been indexed under this class heading in spite of the fact that neither this name nor any synonym of it is mentioned or implied in the title. If this had been done 48 more compounds could have been found, making 63, although they would not, of course, have been tabulated in convenient form as they are in the decennial index. However, it appears that nearly half (52) of the compounds of the benzotriazole group which were described during the ten years, were published more or less incidentally in 17 articles and could hardly have been found conveniently in the best of indexes on the old plan. If a decennial formula index were available the searcher could merely ascertain whether any particular compound had or had not been described.

The *ring index* is an additional, and, so far as is known, original, feature which will enable a user of the indexes to trace down by its formula (he need not know its name), any ring complex, however complicated, and its derivatives as well. Some 450 names of parent rings are listed in the decennial ring index alone, and many of these stand for two or more isomers, so it will be seen that such an index is needed. It is supplemented by a large number of numbered ring formulas in the main index. A list of organic *radical names* (about 330), with their formulas, is also given, so that no doubt will exist as to their meaning.

The present editors of *Chemical Abstracts* are to be congratulated on the many admirable general features of the new indexes, such as the "entry-a-line" plan, abundant use of cross references and notes, indexing of subjects rather than words, etc. One of these features will be of special help to the organic chemist if he will take the trouble to become used to it, namely, the little superior figure at the end of the page reference which indicates the ninth of a page. When the page is full of organic names a great deal of time is saved by narrowing down the choice to one or a few. With a little practice the location becomes very easy indeed.

Xenia, Ohio
August 27, 1919

Austin M. Patterson

AN ACKNOWLEDGMENT

At the 58th Meeting of the American Chemical Society a large banner in the Society's colors was hung in front of the Bellevue-Stratford Hotel. This banner, which is made of the best material and is a beautiful Society emblem, was purchased by Dr. George D. Rosengarten and has been presented to the Society to be kept in charge of the Secretary to be used when needed at future meetings of the Society. I feel also that public acknowledgment should be made of the fact that has heretofore been unknown to the members that Dr. Rosengarten has for some years furnished to the Society the high-grade stationery attractively embossed with the SOCIETY pin, which is used in the offices of the President and Secretary. I feel that these contributions to the SOCIETY's welfare should be known to all of our members and, accordingly, make this grateful acknowledgment here.

CHARLES L. PARSONS, *Secretary*

WASHINGTON, D. C.

LECTURES IN PREVENTIVE MEDICINE
HARVARD UNIVERSITY

Harvard University announces that Dr. Thomas M. Legge, Chief Medical Inspector of Factories in Great Britain, has been invited to give a course of Lowell Lectures and the Cutter Lectures in Preventive Medicine for the coming year. These lectures will be given under the auspices of the School of Public Health of Harvard University and the Massachusetts Institute of Technology, and the Division of Industrial Hygiene. Dr. Legge will lecture in Boston on November 18 and ensuing dates upon the following subjects. The completed schedule of lectures will be issued on October 20.

Twenty Years' Experience of the Notification of Industrial Disease.

Twelve Years' Experience of Workman's Compensation Act and Industrial Diseases.

Medical Supervision in Factories.

Industrial Poisons and Their Prevention.

Anthrax.

Fumes and Gases.

Industrial Fatigue.

Industry as a Subject for Art.

Manufacture under the Mediaeval Trade Guilds.

WASHINGTON LETTER

By J. B. McDONNELL, Union Trust Building, Washington, D. C.

So far as Washington is concerned, the question of what protection will be granted the American dye industry by Congress, probably overshadows other things of interest to the chemical world. The Longworth measure, in brief, provides for increased ad valorem duties, imposes higher specific duties, and has embodied in it the 45 amendments to the existing tariff law which were recommended some time ago by the United States Tariff Commission. The fight that is certain to take place on the bill, however, will come upon its provision for a dye import licensing commission which shall have control of all imports and from whom it will be necessary to obtain licenses for importation of dyes.

Passage of the measure, without changes that will make it materially different, is probable, although the opponents of the measure both among the dye consumers and dye importers have been busily endeavoring to strengthen their lines in Congress. With what success they have met yet remains to be seen; there is, however, little doubt of its passage. The Democratic members of the Ways and Means Committee, led by Representative Kitchen, of North Carolina, have solidly voiced their approval of an import licensing commission as a means of protecting the dye industry. They have also vigorously scored the tariff imposed in the measure as entirely too high, and unnecessary in view of the licensing feature.

Republican members, on the other hand, are in support of the high tariff feature, and the majority are willing to accept the licensing provision if they are convinced it is necessary. While Chairman Fordney of the committee has declared that "he has little faith" in the licensing provision, he has promised that he "will vote with the majority of the committee members in favor of the bill as it stands."

The sentiment in Congress is practically unanimous that the American dye industry should be protected sufficiently to insure its continued growth and development. The Republicans are, naturally, protectionists, and the Democrats have before them the fact that President Wilson specifically mentioned the dye industry as one whose growth should be assured through protection. The question remaining to be solved is the method of protection. So ably was the case of the industry presented before the committee that, with the exception of one or two, members have been satisfied that the main essentials of the Longworth measure are necessary to proper protection.

Representative J. Hampton Moore, of Pennsylvania, recently chosen as the Republican candidate for mayor in Philadelphia, is the chief opponent of the licensing commission. It was the absence from Washington of Mr. Moore, who under a leave of absence from the House was conducting his campaign in Philadelphia, which has been the principal cause of delay in consideration of the bill. Plans to have the measure called up on September 15 met with failure because of the absence from Washington of Chairman Fordney, who under the rules of the House is formally in charge of the bill reported out by his committee.

Representative Longworth has been active in rallying leaders to the support of his measure, however, and several members of the Republican steering committee are among its supporters, Representative Moore has been determined in his opposition. It was at his instance that the hearings before the committee were reopened and several consumers and dye importers were heard by the committee. The reason for his opposition, it is believed, is to be found among certain textile interests in Philadelphia. Mr. Moore also has held several conferences with Herman A. Metz, who is active in his efforts to defeat the licensing commission proposal and has charged several times that the American dye industry has not developed as has been stated by the dye manufacturers.

The great body of the House will follow the leaders in voting on the measure. Republican leaders will support it because of its high tariff, and Democratic leaders will support it for the licensing provision, and although the latter probably will attempt to reduce the tariff rates, they are expected to lend sufficient votes to pass it. Following passage by the House the bill will go to the Senate. There it will be referred to the Finance Committee, of which Senator Penrose, of Pennsylvania, is chairman. In all probability hearings will again be held on the measure before the Finance Committee, and it is safe to assume that opponents of the licensing feature will attend in greater force, and perhaps, better prepared, than was the case during the hearings before the House Ways and Means Committee. As to the probable fate of the measure in the Senate, it is yet too early to speculate. Senator Penrose, however, has said that he will not strongly oppose the licensing commission, having been convinced that a greater number of dye consumers had offered their support to it than had opposed it.

Chairman Fordney has put off consideration of the dye bill until all of the several other tariff measures which have been acted on by his committee have been disposed of. Early in August the House passed the measure introduced by Representative Bacharach, of New Jersey, which provided tariff protection for laboratory glassware, laboratory porcelain ware, optical glass and scentific and surgical instruments. It provides a tariff on glasswares and porcelain wares, laboratory apparatus, and other apparatus and appliances wholly or in part of glass or porcelain, for use in the sciences, or in analyzing or testing or for use in education, of 60 per cent ad valorem. A duty of 45 per cent ad valorem is imposed on philosophical, scientific and laboratory apparatus, utensils, instruments, and appliances and parts thereof, finished or unfinished, and preparations, including boxes and bottles containing the same. Dental and surgical instruments are given the protection of a duty of 60 per cent ad valorem and optical glass and instruments, are assessed 45 per cent ad valorem.

Some other tariff measures have been passed by the House, but these, together with the dye bill, which still is to be acted upon, must go to the Senate, and when they will be acted upon by that body depends largely upon the speed with which the Treaty of Peace is disposed of. This may be passed within a short time or it may take several weeks before action is taken. It is hardly possible that either the dye bill or the scientific instruments measure will reach the floor of the Senate before the middle of October at the earliest, according to present indications.

A supply of German vat dyestuffs, and possibly some other chemicals, is expected to be received in this country within the next sixty days. Dr. Charles H. Herty, editor of the *Journal of Industrial and Engineering Chemistry*, sailed for France early in September as the representative of the War Trade Board Section, State Department, to act with the interallied Reparations Commission in distributing the supply of German dyes.

The War Trade Board has been active for several weeks in obtaining data relative to the needs of dye consumers for the six months' period from October 1 to April of next year. Questionnaires have been sent out to consumers throughout the country asking that the Board be furnished with a list of the dyes required by each consumer. The designation of the dye, its Schulz number, 1914 edition, and the number of pounds needed, are asked for. Incidentally, the form which has been submitted to the dye consumers contains an agreement that the dyes ordered are for the use of those ordering them, and it is agreed that they are not to be re-sold.

Distribution of German dyes and other chemicals has been held up largely because of the lack of American representation upon the Reparations Commission, under whose direction the chemicals will be distributed to the allied countries. According to the provisions of the Treaty of Peace the allied and associated governments have an option on fifty per cent of the dyes and chemicals Germany offers for export, and an option on 25 per cent of the amount offered for export for the next two years. It was to have an American representative advise with the Commission, so as to permit distribution of the German chemicals, that Dr. Herty was commissioned to go abroad.

Reports reaching here are to the effect that the representatives of France, Italy and Belgium, who frankly view the question practically from the standpoint of the consumer, are anxious to obtain immediate distribution and have several times attempted to do so. Up until recently, however, their efforts failed because of the objection of the British and the then American representative, John W. Dulles, who was acting unofficially with the Commission. A limited amount of the German dyes have now been allowed these three countries with the understanding that they are to be used solely for domestic consumption and are not to be re-exported, or used in articles exported. France, under this arrangement, was granted 350 tons of the German dyes. An important conference with regard to the German chemicals and their distribution is to take place in Paris within the next few days, advices reaching here state.

The attitude of the British toward their distribution has been guided almost solely by their determination to protect their own dye and chemical industry as much as possible. Confidential official advices received here quote an official of the British Foreign Office as stating that so far England has received none of the German chemicals and it was the intention to accept just as little as possible. The government, he stated, expected to bring in only a very small amount of the German dyes.

Other reports show that at least some British consumers are not among those who have been impressed with the much heralded progress of the British dye industry. The British industry is short of intermediates, and consequently the choice of the users is limited and they are not permitted the wide variety of shades they desire. It was stated by one of the largest dyers in London that many American dyes were being imported and mixed with colors manufactured in England and sold as British products.

It is the intention of the War Trade Board to continue in force its restrictions against imports of chemicals and dyes. At present chemicals and dyes can only be imported under license. This ruling by the Board gives it effective control over imports from Germany as well as other countries. The power of the Board, however, ceases with the formal proclamation of peace, and thereafter importation may be made freely, subject only to the provisions of the present weak and inadequate tariff law, unless Congress takes action in the meantime upon the pending Longworth measure.

American dye manufacturers will begin placing vat dyes upon the market here by the first of the year, dye consumers of the country were told at a conference held here recently between War Trade Board officials, members of the dye advisory committee of the Board, and a committee on dyes of the National Association of Shirt Manufacturers. The conference was called at the instance of the shirt men, who declared their inability to obtain American vat dyes made it imperative that supplies be obtained from Germany. No opposition to the desire of the shirt manufacturers or other dye or chemical consumers was voiced at the meeting, officials on the contrary outlining just what plans had been made by them for obtaining supplies of German chemicals. It was shortly after this conference that approval of the President was obtained to the appointment of Dr. Herty to go abroad and act for this country in distribution of the German chemicals.

While certain dye consumers, particularly among the textile manufacturers, have been declaring their need for German dyes for several weeks, preliminary reports of the amounts they actually care to order indicate that the total will be a small one. Under the ruling of the War Trade Board, which some time ago was taken over by the Department of State, consumers will be permitted a six months' supply, based, not upon war-time consumption, but upon pre-war consumption figures. This is an important difference from the consumers' point of view, because during the war the use of vat dyes was generally cut down to the barest minimum.

While American potash producers have had some fear of Germany exporting large amounts of potash to this country at prices which they could not meet, reports from Germany continue to state that there is little probability of any large amounts of German potash being shipped to this country. Cost of production has risen in Germany and under the Peace Treaty she has lost large deposits to the French. The French for the present have little desire to ship potash from their own country, and for a time at least it appears as if the production would be consumed in France and Germany, with some going to England, a much shorter haul than to the United States. The prices, too, at which the European potash is offered, are far above pre-war figures, and it is stated that very little can be expected here, and that only at prices not less than three times pre-war costs. A measure providing for protection of the American war-born potash industry through imposition of high tariff duties is pending in Congress. This measure also contains a provision for an import licensing commission which shall have control of all imports, and shall admit foreign potash in decreasing amounts each year.

Work of the scientists of the Bureau of Chemistry of the Department of Agriculture upon new chemical processes and new processes for dyes has been renewed with earnestness, and under an appropriation obtained in the last appropriation bill, officials state they hope to see several new strides made before the end of the year.

September 17, 1919

....

After months of moves and countermoves, the opposition to the Longworth dye bill has been steam-rollered, and that measure, modified somewhat, it is true, but still containing an importing licensing system, passed the House on September 26, and now is before the Senate for final action. As passed by the House the licensing commission as contained in the bill when it was reported from committee was amended, so as to place the import licensing authority under the Tariff Commission. The final vote on the measure was 156 for and 119 against passage.

Passage of the dye bill came after a final day of bitter fighting, in which the opponents resorted to every subterfuge to defeat the licensing proposal. Most of the battle took place in the House, sitting in committee of the whole House. It was on the first record vote in the House proper, demanded by Representative Cannon, of Illinois, on the amendment placing the administration of the licensing system under the Tariff Commission, that the opposition was shattered with 206 votes in favor and only 62 opposed to the amendment.

The fight against the licensing system was led by Representative Moore, of Pennsylvania, and Representative Fordney, of Michigan, chairman of the Ways and Means Committee. Only a solid Democratic vote, and the efforts of Republican leaders to rally a divided following, brought about passage of the bill with a licensing provision in it. The first victory of the dye manufacturers has been scored in one of the bitterest and most complicated fights staged in the House on a tariff measure in recent years.

Representative Moore, leader of the opposition, directed his chief attack, throughout the hearings before the Committee, and debate on the floor which occupied four days, at the motives of the founders of the Chemical Foundation. The import licensing scheme, he reiterated again and again, was one put forward by the du Pont and the National Aniline and Chemical companies in order to build up a monopoly through which they might gouge the dye consumers of the country. It must be said that, at best, Mr. Moore's case as he presented it, was but a poor one.

The bill now goes to the Senate. There it will be referred to the Senate Finance Committee, which will hold hearings on it and report it back to the Senate, which must then act upon it before the bill becomes law. Engrossed in the fight on the Treaty of Peace, it is difficult to say when definite action will be taken by the Senate. It is not expected for several weeks at least.

September 27, 1919

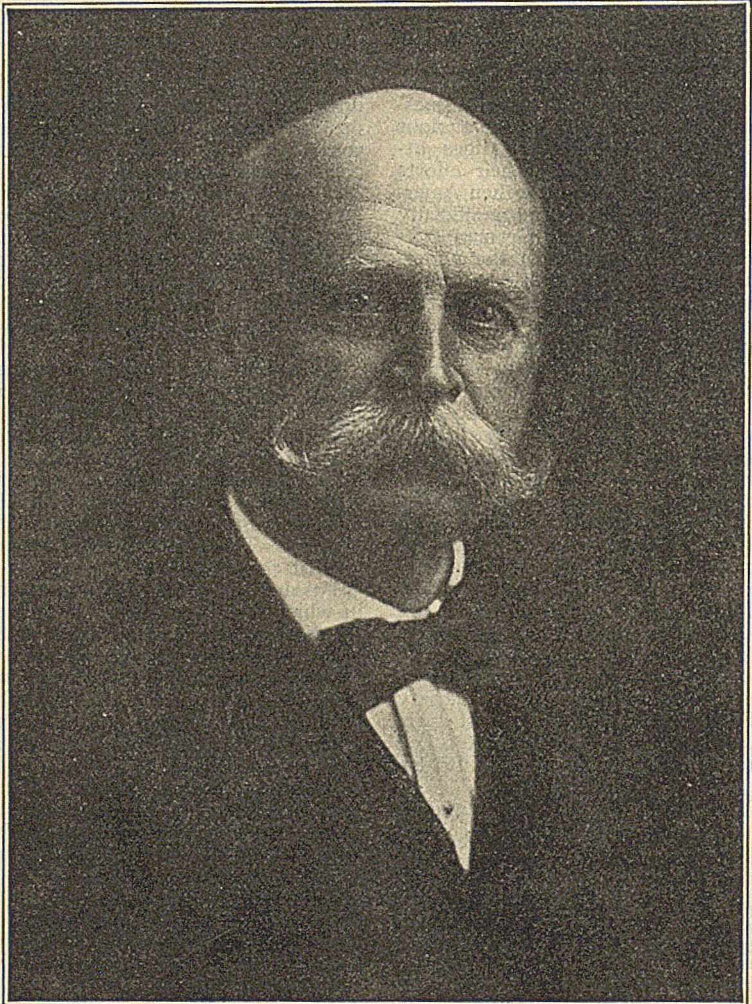
OBITUARY

EDWARD G. LOVE

AN APPRECIATION

Dr. Edward G. Love, treasurer of the AMERICAN CHEMICAL SOCIETY, died on September 11, 1919, in Roosevelt Hospital, New York City, from shock following a capital operation, in his 69th year. Dr. Love was a well-known figure among American chemists both at home and abroad. He was always active in the interests of the SOCIETY, as well as diligent in attendance at its meetings. There may be counted among his special contributions the establishment and organization of its library, now incorporated with that of the Chemists' Club.

Dr. Love was a veteran of the Civil War, in which he enlisted as a drummer boy in 1864. He first studied at Hamilton College, which he entered in 1868, being graduated in 1872. He then attended the School of Mines of Columbia University, studying chemistry under Professor Chandler, whose assistant he became after obtaining his diploma in 1876. Later he also received his doctorate in philosophy at Columbia. In 1877 he was appointed the first gas examiner for New York City. Establishing a general analytical laboratory down town, he became analyst for both New York State and City Boards of Health, and was recognized as an authority on the chemical tests of foods. As municipal gas examiner he had to do with many competing companies and with contracts that often made demands on his diplomacy no less exacting than on his chemical scholarship. In his hands the city's interests were always safe, conserved with sterling integrity, and administered without friction. He had a happy faculty of meeting difficulties without borrowing trouble or permitting quarrels to intervene. In 1913 the Consolidated Gas Company made him its chief chemist, whereupon he gave up his official connection with the city and his private practice. With his clear scientific intelligence he soon became as proficient in the principles of making gas as he had shown himself in testing it. It was largely due to his energetic work that the Company was enabled to separate its toluene for the use of the Government in making TNT when this was one of the products most ardently sought for war purposes. His quick response to the demand for toluene, as soon as this was uttered, was a splendid war contribution.


EDWARD G. LOVE

Dr. Love took his work seriously; generally he was the last to leave his office or laboratory, but once away from his task he was a prince of good fellows, and a delightful companion. Perhaps his most engaging attribute was his boyish enthusiasm that, once aroused, seemed to know no bounds. He was president of the Chemists' Club in 1902, and when it moved, in 1911, to the present quarters, he became chairman of its House Committee, holding this office through several administrations, and by the unstinted expenditure of his energy and his substance he did much to promote that rare spirit of camaraderie that pervades the place to this day. Entomology was his avocation and he leaves a valuable collection of specimens. He was a member of many learned societies and institutions.

ELLWOOD HENDRICK

HIS RELATION TO THE SOCIETY

When I accepted the secretaryship of the AMERICAN CHEMICAL SOCIETY in 1907, Dr. Love was librarian of the SOCIETY and I need make no mention of the work that he did while holding that office, and of the hours he spent, often way into the night in the old library, arranging the publications, filling out incomplete volumes, and getting them in form for future use. Others have already called attention to the fact that the present library of the Chemists' Club is largely due to his efforts, and this library contains all of the collections made by the AMERICAN CHEMICAL SOCIETY in the past. In addition to his work as librarian, Dr. Love was handling all the changes of address for the SOCIETY, he had full care of the mailing lists, of the stock of back numbers, of the subscriptions and of the sales of back journals, and this work to-day with the increased compilation of mailing lists and a largely increased membership is a goodly portion of the work of the present secretary. In 1908, by arrangement of the Business Committee, all of this work which Dr. Love was doing was given over to the secretary's office, but almost simultaneously with this change, when it seemed that Dr. Love was to be relieved, he was appointed to and accepted the chairmanship of the Finance Committee. He was a live chairman, and found work to do—work which was not always attended to properly before it came into his hands. On September 27, 1916, he was elected treasurer of the SOCIETY.

No bill was paid by the AMERICAN CHEMICAL SOCIETY that did not pass through his hands; no officer of the SOCIETY could draw one cent over the appropriation made to him, and if there was the slightest inaccuracy in any bill, whether in arithmetic or in a divergence from contract conditions, Dr. Love always found it. 'I have never known an error to get by him, nor have I known an officer of the SOCIETY who has ever been able to overrun his appropriation, or, for that matter, to draw near to its exhaustion without being checked up by Dr. Love, and the matter brought to the attention of the Directors.

Dr. Love did all of this work quietly, unassumingly, apparently without the slightest desire for compensation, even in the appreciation of his fellow chemists, but this appreciation has come to him, for such work as he has done is invaluable and cannot be hidden. He was a splendid, clear thinking, accurate business man, a gentleman through and through, a loyal and devoted friend to all chemists, and a real man. His place cannot be filled.

CHARLES L. PARSONS

INDUSTRIAL NOTES

The War Trade Board Section of the Department of State has determined to permit the importation of vat dyes from Germany in quantities sufficient to supply the requirements of the consumers of the United States for the six months' period October 1, 1919, to April 1, 1920. Importations of these articles will be governed by rules and regulations which will be announced as soon as the necessary details have been completed. In the meantime, users of vat dyes have been requested to file with the War Trade Board Section applications giving their estimates of the amounts of vat dyes which will be required for consumption in their plants during the above mentioned six months' period.

Prominent educators and chemists of this country and Canada have organized the American Society of Biological Chemists, Inc., which has received the approval of the Supreme Court to its application for a certificate of incorporation. The temporary directors stated in their petition that the society's purpose was "to further the extension of biochemical knowledge and to facilitate personal intercourse between American investigators, in biological chemistry." The society's headquarters will be established in New York City. Under the by-laws adopted, the annual meeting will be held the last Monday of December each year and seven directors will be elected to direct the affairs of the society. The petitioners for incorporation and temporary directors are: Andrew Hunter, of the University of Toronto; Lafayette B. Mendel, of Yale University; E. V. McCollum, of Johns Hopkins University; Harold C. Bradley, of the University of Wisconsin; Victor C. Myers, of New York City; Donald D. Van Slyke, New York City, and Stanley R. Benedict, of New York City.

The Interstate Commerce Commission has issued a supplement to the regulations for the transportation of explosives and other dangerous articles by freight and express and specifications for shipping containers. It contains changes and new matter relating to inflammable liquids, zinc dust, arsenic, arsenate of lead, calcium arsenate, etc., and manufactured articles made from or containing pyroxylin plastics.

Edgewood Arsenal has listed the following surplus materials:

Acid, picric	195 tons
Acid, sulfuric	253,076 tons
Chlorine, liquid	589.5 tons
Kaolin	44 tons
Phosgene	78 tons
Sodium silicate	7 1/2 tons
Sulfur chloride	2,500 tons
Titanium tetrachloride	72 tons
Turpentine	30 tons
Gas masks	1,264,080 approx.
Canisters	82,221 approx.
Locomotives, gasoline	6

Any inquiries regarding same should be addressed to Materials' Disposal Section, attention Captain E. C. Thompson, Edgewood Arsenal, Edgewood, Md.

Among the plaintiffs associated with the Chemical Foundation, Inc., in the suit against Robert C. Harrison, doing business as the Anglo-French Drug Company, for infringement of patents for the manufacture of arsphenamine and neo-arsphenamine, are the Dermatological Research Laboratories, the Takamine Laboratory, the Diarsenol Company, and the H. A. Metz Laboratories. Importations of these products, known as salvarsan and neo-salvarsan, are said to have been made through the principal ports of the Pacific Coast and Atlantic Coast, coming from Tokio, London, and Paris. Further large shipments are expected from Europe, it is said in the complaint which was filed, and an application for an injunction was made to prevent the sale of the imported goods.

At the recent annual meeting of the American Zinc Institute it was decided to set aside $25,000 for research and for a campaign advertising new uses of zinc.

The American Aniline Products, Inc., New York, was the successful bidder for 6,018 shares of the German-owned capital stock of the Roessler & Hasslacher Chemical Company, sold at public auction by the Alien Property Custodian at the New York offices of the Custodian, recently. The price paid was $505 per share, totalling $3,039,090 for the 6,018 shares. The 110 shares of stock of the Niagara Electrochemical Company of New York were also purchased by the American Aniline Products, Inc., in conjunction with W. E. Coffin at $4,000 per share, totalling $440,000 for this block. The same syndicate was successful in securing 1,960 German-owned shares of the stock of the Perth Amboy Chemical Works, of New Jersey, for which they paid $480 per share, or $930,800. For 4 months ending April 30, 1919, the gross sales and net incomes of the respective companies were as follows: Roessler & Hasslacher Chemical Company, sales $3,814,435.84, net income $40,039.15; the Niagara Electrochemical Company, sales $2,063,764.59, net income $128,162.45; the Perth Amboy Chemical Works, sales $1,019,887.74, net income $262,280.27.

Contract has been awarded by the Dewey & Almy Chemical Co., Boston, Mass., for the erection of a new one-story plant to be located on Harvey Street, Cambridge. The structure will be about 100 x 100 feet.

Work has recently been commenced by the Maas and Waldstein Co., Newark, N. J., on the reconstruction of the section of its chemical plant recently destroyed by fire, with loss estimated at $100,000.

The plant of the Texas Creosote Manufacturing Company at Forth Worth is rapidly nearing completion, and is practically ready for operation. Creosote, rubberoid and roofing will be made. The first unit of three stills has been completed and will have a capacity of 6,000 gals. per hour. Three other units are to be built. It is planned to manufacture a number of other products from fuel oil, a plentiful supply of which will be had from refineries adjacent to the new plant.

The Southern Agricultural Chemical Corporation, which is a subsidiary of the Tennessee Copper & Chemical Corporation, has been incorporated in Virginia with a capitalization of $1,000,000. The new company is expected to become a very important factor in the fertilizer field inasmuch as it will handle the entire output of sulfuric acid and acid phosphate of the Tennessee Company. The officers of the new company are Adolph Lewisohn, president; Sam A. Lewisohn, E. H. Westlake and A. H. Sterne, vice presidents; and F. M. Loper, secretary and treasurer. The principal office of the company will be at 61 Broadway, New York, with southern headquarters in Atlanta, Ga.

The War Industries Board has issued a series of bulletins covering the history of prices of various commodities. The chemical group includes the following titles:

Mineral acids
Heavy chemicals
Miscellaneous inorganic chemicals
Fertilizers
Soaps and glycerin
Essential oils, flavoring, and perfumery materials
Wood distillation products and naval stores
Natural dyestuffs and tanning chemicals
Coal-tar crudes, intermediates and dyes
Drugs and pharmaceuticals
Proprietary preparations
Explosives
Miscellaneous organic chemicals

Copies may be secured from the Superintendent of Documents, Government Printing Office, Washington, D. C.

The Eastern Oil Co., Suffolk, Va., is planning a new plant for the manufacture of cottonseed and peanut oils, with daily capacity of about 75,000 tons. The plant, with machinery and equipment, is estimated to cost about $125,000.

The Snyder & Swain Corporation, Newark, N. J., manufacturer of chemicals, is planning the erection of a six-story, reinforced concrete building to cost about $200,000.

The recent figures of the U. S. Geological Survey indicate a greater production of crude oil for June 1919, than for any month during the last year and a half, credit for which is given to Central and North Texas. The production for the first six months of 1919 as compared to the first six months of 1918, indicates a greater production for the year 1919 than for 1918. The production for the first six months of 1918 was 172,000,000 barrels, while for the first six months of 1919 it was 177,000,000 barrels, or an increase of 5,000,000 barrels.

The production of talc in the United States has increased about 90 per cent in the last ten years. During this period the production of ground talc has increased about 115 per cent. This indicates a great expansion in the use of this grade of material, and suggests the possibilities of even greater expansion under favorable conditions. These conditions can be brought about through technical research and publicity. Over forty uses for talc are now known, of which only a few have been exploited at all extensively. The principal uses of ground talc at present are in the paper, paint, rubber, roofing, and toilet powder industries.

A gum which is in demand by the manufacturers of perfumes, tobacco, adhesives, and pharmaceutical preparations, is produced by the red gum tree (*Liquidamber styraciflua*) of the South, though few owners of this tree apparently are yet aware that the gum has any commercial value. The properties and composition of this "sweet gum," as it is called, are similar to those of oriental storax, obtained from a tree (*Liquidamber orientalis*) which grows in Asia Minor. Cinnamic acid and cinnamic alcohol are two of its valuable components. Because the war curtailed the supply of the imported product, the U. S. Forest Products Laboratory this season undertook some coöperative experiments to develop methods of gathering "sweet gum" or "American storax." Although the yield of gum from each tree is not large, a price of $2 or more a pound has made its collection attractive to many individual operators, and a considerable quantity has been put on the market. The laboratory experiments will be completed in November, and it is hoped that they will provide some cost data which will indicate to what extent "American storax" can profitably compete with the foreign product when normal conditions return.

The American Electrochemical Society has issued a pamphlet giving a reference list of firms engaged in the electrochemical industry and their products, and a second list of electrochemical products with the names and firms producing them. The Bulletin may be secured by addressing the secretary of the society at South Bethlehem, Pa.

At Lancaster, Mass., occurs a deposit of fuller's earth which has been worked intermittently since 1856. While this earth possesses most of the properties common to other fuller's earths it has the additional characteristic of breaking down upon drying, and without crushing, to a closely uniform, fine product, free from grit, which will pass through a screen of about 250-mesh. While this property makes the material unfit for some uses, such as a filtering medium, it is peculiarly well adapted to certain other uses. In the fulling of woolen cloth uniformity, fineness, and freedom from grit are essential, for grit or pebbles abrade and cut holes in the cloth as it passes over the rolls. Fuller's earth not only removes any grit remaining in the wool, but helps to flow the dye uniformly over hard-finished woolens. The earth from this deposit has been used in the woolen industry for over 60 years. Another use has been developed in recent years dependent not upon its absorbent action, but upon its value as a binder when fused. Manufacturers of abrasive wheels and stones made both from natural and from artificial abrasives have used this earth as a binder.

The inactivity of the Russian platinum mines has caused a corresponding increase in activity in Colombia. A large company has recently been formed to operate in Colombia, which is reported to hold 10,000 acres of land as well as 50 miles of river bottom. The operations of this company should materially increase the output of platinum from Colombia. A substitute for platinum in electrical apparatus has been the object of some private investigations. One satisfactory substitute for cathodes was found to be 90 per cent gold and 10 per cent copper. The same alloy was found suitable as an anode after being electrically coated with a thin layer of platinum and then carefully polished and burnished.

Virginia-Carolina Chemical Company's annual report for the year ended May 21, 1919, shows surplus, after Federal taxes and charges, of $6,665,256, equivalent after preferred dividends to $18.08 a share earned on the $27,984,400 common stock as compared with $8,384,668 or $24.24 a share in the preceding year.

The Potash Salts Bill (H. R. 4870) providing for licensing control of imports of potash salts in the interests of potash salts producers is still in the hands of the Ways and Means Committee, and it is not known when it will be reported out. No definite decision has been reached with regard to the Bill. There seems to be a desire to aid the potash salts industry, but there is difficulty in meeting the objection of the ultimate consumers, the farmers and others who contend that any restrictions on the importation of potash salts will aid materially to the cost of fertilizer and be reflected in the cost of living.

An explosion of chemicals, from an undetermined cause, started a fire in the plant of the McCoy-Howe Chemical Company, manufacturers of pharmaceutical supplies, Indianapolis, causing a loss estimated by officials of the company at between $15,000 and $20,000.

An exposition of the manufactured and other products of the Mississippi Valley will be held in St. Louis, Mo., this fall from October 27 to November 8. Various civic and commercial organizations are coöperating and all manufacturing enterprises in the Mississippi Valley have been invited to exhibit.

The semi-annual statement comparing the profit and loss of the General Chemical Company for the first six months of the present year, with those for the corresponding period of last year, was issued recently. The statement, signed by Lancaster Morgan, treasurer of the company, shows a decline in the net profits of the company of $1,482,235.97, or more than 65 per cent of the net profits for 1918. A further statement to the effect that the surplus shown on the books of the company at the time of its last report to stockholders has been reduced by $1,363,679.07 for plant amortization is a feature of the report.

Chemical and dye companies of Chicago, which have recently been voted in as members of the Association of Commerce, are the Sherwin-Williams Company, manufacturers of paints, varnishes, dyes and chemicals; the Lithflux Mineral and Chemical Works, and the Semet-Solvay Company, manufacturers of coal-tar products.

The Baltimore Cork Company has purchased the property of the Wilson Distillery and will remodel it for the purpose of manufacturing crown cork and other cork products. The company expects to employ from 300 to 500 operatives, and it is estimated that the capacity of the plant will exceed $1,000,000 annually.

The absorption of a number of British glass works is being brought about by the recently organized British Glass Industries, Ltd., which was registered officially a few months ago, to take over the glass works at Canning Town (London) and at Leeds. An arrangement has just been completed by the new concern to take over the whole of the shares of the Queensborough Glass Bottle Works, Ltd., one of the largest and most important concerns of its kind in Great Britain. In addition the company has also acquired the business of Payne Bros., who have been trading as the British & Foreign Bottle Company, for which an aggregate price of £400,000 was paid. The new combination will control over 30 furnaces when 20 furnaces now being erected at Canning Town have been completed. This will make the company the largest of its kind in all Europe.

A good deal of attention is being given to the extraction of algin from kelp. Algin is a vegetable gum of extremely high viscosity whose properties are widely known. It is manufactured and used in Europe, but so far the industry has never become well established in this country, probably because of difficulties in securing a uniform supply of fresh kelp at a reasonable cost. The experience gained by the Hercules Powder Company in harvesting kelp for the manufacture of war materials has overcome many of these difficulties.

There is a wide field of possible usefulness for algin. Its compounds in general give an exceedingly viscous solution, and for that reason their application as a sizing for textiles and paper, as a thickener for printing colors, and as proofing for interior walls and ceilings is at once apparent. The sodium compound of algin is soluble in water, a five per cent solution thereof being so viscous that it can hardly be poured from a vessel. The compounds of the heavy metals with algin are insoluble in water, some of them being soluble in ammonia, which solvent is used in their application as a waterproofing material in textiles.

An Institute of Industrial Hygiene, for graduate instruction in the sanitation and care of the health of employees in industrial enterprises and the scientific study of industrial diseases and accidents is to be established by Columbia University.

The Hafleigh Rendering Company, Philadelphia, is planning for the rebuilding of the portion of its fertilizer works recently destroyed by fire with a loss of about $40,000.

PERSONAL NOTES

Dr. Chas. H. Herty, Editor of THIS JOURNAL, sailed for Europe on September 3, having been appointed by President Wilson to secure for the American dye consuming industry a six months' supply of vat dyes from the stocks now held by the Reparations Commission, under the terms of the Peace Treaty. It is expected that before the expiration of the six months period American producers of vat dyes will be ready to supply the needs of the consumers. Dr. Herty will be absent about two months. During his absence Miss Lois W. Woodford is Acting Editor.

Dr. John E. Teeple, 50 E. 41st St., New York City, has been elected Treasurer by the Directors of the AMERICAN CHEMICAL SOCIETY to fill the unexpired term of Dr. E. G. Love.

Lt. Martin Meyer, Infantry, has returned to the College of the City of New York as Fellow, as has also **Moses Chertcoff** of the National Army.

Mr. W. C. Marckworth has left the casinghead gasoline division of the Ohio Cities Gas Company, Columbus, Ohio, and has entered upon research work in the refining division of the same company at Marcus Hook, Pa.

Prof. Alexander Smith, head of the Department of Chemistry of Columbia University, has received the Honorary Degree of Doctor of Laws from the University of Edinburgh, Scotland, from which he was graduated.

Mr. James W. Martin, Jr., who has been discharged from the Service, is now with the National Carbon Company, Cleveland, Ohio, where he has charge of their development laboratory.

Mr. W. G. Crockett, who since his discharge from the Chemical Warfare Service has been employed as a chemist with E. I. du Pont de Nemours & Co., Wilmington, Del., was recently elected professor of pharmacy in the College of Pharmacy of Baylor University, and is also opening a chemical laboratory for analytical and consulting work.

Miss Ruth Okey has resigned as instructor in physiological chemistry at the University of Illinois to accept a position as assistant professor of household science at the University of California.

Dr. L. H. Baekeland, Honorary Professor of Chemical Engineering in Columbia University, has been decorated by King Albert with the Order of the Crown of Belgium.

Mr. Wilmer C. Powick, formerly in the Sanitary Corps of the U. S. Army, having served in France for twenty-two months, attached to the Interministerial Research Commission and assigned for duty to Professor Lapicque of Le Laboratoire du Museum, Paris, who was then in the service of the French Ministry of Armament, has recently been discharged from the Army, and has resumed his pre-war duties as biochemist, U. S. Bureau of Animal Industry, Washington, D. C.

Major F. E. Breithut, Chemical Warfare Service, has been honorably discharged from the Army and has resigned as assistant professor of chemistry at the College of the City of New York to take a position with the Foundation Oven Corporation, Woolworth Building, New York City.

Mr. L. E. Kelly, formerly assistant material engineer, Bureau of Construction & Repair, Navy Department, Washington, D. C., has entered the Sales Department of the Eagle-Picher Lead Company, Chicago, Ill.

Mr. Walter F. Meister, formerly chief chemist for the Eagle-Picher Lead Company, is now chief chemist for the Collinsville Zinc Corporation at Collinsville, Illinois.

Mr. Joseph E. Plumstead has resigned from his position with The Celluloid Co., of Newark, N. J., where he was doing development work, to accept the position of assistant superintendent of the Delaware Mills plant of The Jessup & Moore Paper Co., and consulting chemist for their five pulp and paper plants.

Mr. J. H. Calbeck, recently First Lieutenant, Chemical Warfare Service, U. S. A., A. E. F., is now in the research laboratory of the Eagle-Picher Lead Company, of Joplin, Mo.

Mr. Robert Fogelson, who was with the research division, Chemical Warfare Service, has accepted a position with the Newport Chemical Works, Inc., Carrollville, Wis., as chemist.

Prof. Lauder W. Jones, now dean of the School of Chemistry at the University of Minnesota, was appointed dean of the College of Engineering and Architecture, at a recent meeting of the Board of Regents of the University of Minnesota. Professor Jones has assumed the duties of his new office and will continue to occupy the office of dean in both these schools.

Mr. E. N. Ehrhart, formerly Ensign in the U. S. Navy, is now located at Franklin, La., as chief chemist for the Sterling Sugar and Railway Co., Ltd., a 2,000-ton capacity sugar house.

Prof. Merle Randall, of the department of chemistry of the University of California, has returned to Berkeley after having spent the summer as research chemist in the laboratories of the Experimental Kelp-Potash Plant of the U. S. Department of Agriculture, at Summerland, California.

Dr. Samuel A. Tucker, formerly professor of electrochemistry at Columbia University, and who served as Major in the Chemical Warfare Service, is now chief chemist for the Chemical Foundation, Inc.

Mr. R. W. Frey, formerly with the leather and paper laboratory, Bureau of Chemistry, U. S. Department of Agriculture, Washington, D. C., has accepted a position in the chemical department of John H. Heald & Co., Inc., manufacturers of tanning and dye-wood extracts, and will be located at the main plant at Lynchburg, Va.

Mr. Charles B. Spofford, Jr., has resigned as manager of the Crane Felt Company, Belvidere, N. J., and has accepted a position as chief chemist for the Angus Jute Co., Ltd., Calcutta, India, and until he sails, November 27, will be with the Bemis Brothers Bag Company, of Boston.

Mr. Jack A. Thomas has resigned his position as department manager of the Rollin Chemical Company, Inc., Charleston, W. Va., in charge of the chlorinated products section, to make an extended trip to higher altitudes to regain his health.

Mr. Jerome D. Stein, formerly control supervisor of the Nitrate Division, U. S. Nitrate Plant, No. 2, Muscle Shoals, Ala., has accepted a position with the Gordon Dryer Corporation, N. Y., in their development department.

Mr. William H. Harrison, formerly deputy dairy and food commissioner with the State Dairy & Food Department, Des Moines, Iowa, is now director of inspection of the Iowa District for the National Canners Association, Ames, Iowa.

Mr. Paul A. Keene, who for the last fourteen months has been engaged in government nitrogen fixation work in both enlisted and civilian capacities, has accepted a position with the Solvay Process Company, and is now located at their laboratory in Syracuse, N. Y.

Mr. R. V. Cook, recently research engineer with the Koppers Co., of Pittsburgh, has joined the sales-engineering staff of the Brecht Co., St. Louis, Mo.

Dr. F. G. Cottrell, chief metallurgist in the U. S. Bureau of Mines, has been named assistant director in charge of investigative and scientific work. Other changes in the Bureau are the appointment of the former chief clerk, **Mr. F. J. Bailey,** as assistant to Director Manning in charge of executive work, and **Mr. H. W. Meyer,** chief clerk of the War Minerals Relief Commission, to be chief clerk of the Bureau, succeeding Mr. Bailey.

Dr. R. A. Baker, recently Major, Chemical Warfare Service, and Commandant of the U. S. Gas School at Camp Kendrick, N. J., and prior to which service he was assistant professor of inorganic chemistry at the University of Minnesota, has been appointed professor of general and inorganic chemistry at Syracuse University.

Mr. Alfred C. Chambers, recently resigned his position as chief of the Quality of Water Division, Water Resources Branch of the Geological Survey, to accept a position as chemist in the laboratory of The Youngstown Sheet & Tube Co., Youngstown, Ohio.

Mr. Arthur S. Schulhoff has resigned his position as chief chemist at the Hermon, N. Y., plant of the Nestles Food Company in order to resume the study of chemistry at the Massachusetts Institute of Technology.

Mr. Harry I. Johnson, formerly assistant professor of chemistry at the University of Louisville, will be employed in a similar capacity at the North Carolina State College, W. Raleigh, N. C., this coming year.

Mr. A. G. Davis, formerly of Delicias, Cuba, is now with the central control laboratory of the Cuban-American Sugar Company, Cordenos, Cuba.

Mr. Ralph C. Holder, who was discharged from the Chemical Warfare Service last December, having been stationed at the American University, Washington, D. C., is now chemist at the U. S. Department of Agriculture, Food Research Laboratory, Indianapolis, Ind.

GOVERNMENT PUBLICATIONS

By R. S. McBride, Bureau of Standards, Washington

NOTICE—Publications for which price is indicated can be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C. Other publications can usually be supplied from the Bureau or Department from which they originate. Commerce Reports are received by all large libraries and may be consulted there, or single numbers can be secured by application to the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington. The regular subscription rate for these Commerce Reports mailed daily is $2.50 per year, payable in advance, to the Superintendent of Documents.

WAR DEPARTMENT

Electrical Apparatus and Wiring Supplies. War Department Catalogue 6. 162 pp. Issued by the Engineering and Standardization Branch of the Purchase, Storage, and Traffic Division, May 1, 1919. An illustrated outline of War Department Standards.

The Principles Underlying Radio Communication. Radio Pamphlet 40. 355 pp. Fabricoid, 55 cents. Prepared by the Bureau of Standards under the direction of the Office of the Chief Signal Officer of the Army Training Section. "Acknowledgment is made of the valuable service rendered the Signal Corps by the Bureau of Standards through the work of Dr. J. H. Dellinger and the following men engaged with him in the writing of this book: F. W. Grover, C. M. Smith, G. F. Wittig, A. D. Cole, L. P. Wheeler, and H. M. Royal. In this book are presented briefly the basic facts and principles of electromagnetism and their application to radio communication. In the effort to present these topics in a simple manner for students with very little mathematical preparation it has been necessary at times to use definitions, illustrations, and analogies which would not be used in a work prepared for more advanced students. Frequent references to standard books are given for further study, and students should be encouraged, as far as possible, to consult them."

America's Munitions, 1917–18. Report of B. CROWELL. (Edited by R. J. BULKLEY, R. F. WILSON AND B. E. LING.) 592 pp. 218 pp. of plates. Cloth, $2.00.

NATIONAL ACADEMY OF SCIENCES

Triad Systems. Memoirs of National Academy of Sciences, 1919. Vol. 12, 2nd memoir. 89 pp. Paper, 15 cents.

CONTENTS—Complete classification of triad systems on 15 elements, [articles] by H. S. White, F. N. Cole, and Louise D. Cummings: Pt. 1, Triad systems on 15 elements whose group is of order higher than unity, by H. S. White; Pt. 2, Trains for triad systems on 15 elements whose group is of order higher than unity, by L. D. Cummings; Pt. 3, Groupless triad systems on 15 elements, by H. S. White and L. D. Cummings; Pt. 4, Structure as defined by interlacings, heads, and semiheads, complete census of triad systems in 15 elements, by F. N. Cole; Pt. 5, Sequences and indices for all groupless triad systems on 15 elements, by L. D. Cummings.

NATIONAL ADVISORY COMMITTEE FOR AËRONAUTICS

Nomenclature for Aëronautics. Report 25. 11 pp.

SUPERVISING ARCHITECT TREASURY DEPARTMENT

Specification for Lubricating Oils, Fiscal Year 1920. For Use in Public Buildings under Control of Treasury Department. 7 pp.

PUBLIC HEALTH SERVICE

A Department of Health for Canada. Public Health Reports, 34, 1973–6 (August 29).

An Investigation of the Changes in the Blood and Urine Resulting from Fatigue. A. B. HASTINGS. Public Health Reports, 34, 1682–90 (August 1).

Water for Drinking or Culinary Purposes Provided on Cars and Vessels by Interstate Carriers. Amendment 8 to Interstate Quarantine Regulations of 1916.

City Health Officers, 1919. Issued July 4, 1919. This gives the public health officers of cities of 10,000 populaton and over.

The Standardization of Pituitary Extracts. R. A. SPAETH. Hygienic Laboratory Bulletin No. 115, Part II.

Regulations for the Sale of Viruses, Serums, Toxins, and Analogous Products in the District of Columbia and in Interstate Traffic. Miscellaneous Publication No. 10. Dated February 12, 1919.

Sale of Condensed Milk. Public Health Reports. Vol. 34, p. 1430. Issued June 27, 1919. United States Supreme Court decision under Ohio law. An Ohio statute prohibited the sale of condensed milk unless made from pure unskimmed milk. The United States Supreme Court has decided that this law prohibits the sale of an article consisting of condensed skimmed milk and a vegetable fat, although not sold as condensed milk.

The Dust Hazard in the Abrasive Industry. C. E. A. WINSLOW, L. GREENBURG AND D. GREENBURG. Public Health Reports, 34, 1171–1187 (May 30, 1919).

Trinitrotoluene Poisoning. C. VOEGTLIN, C. W. HOOPER AND J. M. JOHNSON. Public Health Reports, 34, 1307–1311 (June 13, 1919). From a paper read at the annual meeting of the American Federation of Biological Societies in Baltimore, Md., April 24, 1919.

FUEL ADMINISTRATION

Prices and Marketing Practices Covering Distribution of Gasoline and Kerosene throughout the United States. A. G. MAGUIRE. 24 pp. Prepared in Bureau of Prices and Licenses, Oil Division.

Prices of Petroleum and Its Products during the War. J. E. POGUE AND I. LUBIN. Prepared by Oil Division of Fuel Administration in coöperation with Planning and Statistics Division of War Industries Board. 55 pp. Paper, 5 cents. Also issued as War Industries Board Price Bulletin 36.

BUREAU OF THE CENSUS

Census of Manufactures, 1914, Vol. II. Reports for selected industries and detail statistics for industries, by states. 1,047 pp. 9 maps. 14 text fig. This work presents data for certain selected industries which have been issued sometime since as separate bulletins and are collected in the present volume. In addition are given in detail the statistics for each industry included in the census, by states. Report distinguishes 344 industries, although for certain purposes some of these are subdivided into two or more subclassifications. There are 271 of these subgroups of industries; thus separate totals are given for 615 industries or subclasses of industry.

Textile Fibers; Wool, Silk, Jute, and Kapok; Census of War Commodities, 1918. 16 pp. This gives statistics of wool, silk, jute, and kapok, gathered by the Bureau during war period, at request of the War Industries Board, to ascertain available stocks, data bearing upon consumption and products, and machinery capacity of country for textile production in certain cases, which were used by various war activities of Government.

Statistical Abstract of United States, 1918. 897 pp. Paper, 40 cents. This presents in condensed form statements regarding commerce, productions, industries, population, finance, currency, indebtedness, and wealth of country for series of years, compiled from more important statistical data collected by various government departments; also condensed statement of commerce of principal foreign countries.

Cotton Production in United States, Crop of 1918. 39 pp. This paper presents a series of tables giving statistics of cotton ginned from the crop of 1918 for United States, several states, and individual counties.

Antimony and Graphite Crucibles; Census of War Commodities. 10 pp. This consists of statistics gathered during war period by Bureau in endeavor to ascertain stocks of antimony available for war activities and for requirements of both peace and war industries, and which were given as soon as compiled to various war agencies of Government. Statistics showed antimony content of stocks on hand, in transit, and afloat; imports and exports for fiscal years ended June 30, 1918 and 1917; and consumption and production.

BUREAU OF MINES

The Determination of Combustible Matter in Silicate and Carbonate Rocks. A. C. Fieldner, W. A. Selvig, and G. B. Taylor. Technical Paper 212. 22 pp. Paper, 5 cents. Issued April 1919. Owing to the presence of combined water in shale and clay, and of carbon dioxide in carbonate rocks, the percentage of combustible matter in these materials cannot be calculated from the loss on ignition, as is done in coal and other fuels containing a relatively small proportion of constituents that are incombustible; neither can the combustible be taken as the sum of the total carbon and hydrogen as obtained in the ordinary ultimate analysis, for in both these methods the organic matter is oxidized to water and carbon dioxide, simultaneously with the liberation of water and carbon dioxide from the hydrous silicates and inorganic carbonates in the rock. Therefore, special methods are required that will differentiate between the organic and the inorganic carbon and hydrogen.

Petroleum Investigations and Production of Helium. Van H. Manning. Bulletin 178-C. 24 pp. Issued June 1919. Advance Chapter from Bulletin 178, War Work of the Bureau of Mines.

Vitiation of Garage Air by Automobile Exhaust Gases. G. A. Burrell and A. W. Gauger. Technical Paper 216. 12 pp. Paper, 5 cents. Issued April 1919.

Recent Developments in the Absorption Process for Recovering Gasoline from Natural Gas. W. P. Dykema. Bulletin 176. 90 pp. Paper, 25 cents. Issued April 1919. This report gives the results of a study conducted by the Bureau of Mines for the purpose of informing the petroleum industry on the recent progress in the development and application of the absorption process for recovering gasoline from natural gas. The work has been undertaken entirely with regard to plant practice and for the purpose of describing the features and the operation of units of the plants now in use, the improvements that have been made, and the reasons for any changes contemplated by the engineers in charge of the plants studied.

Throughout the United States the improvements in the absorption process that are under consideration by engineers not only widen practice so as to include gases at all pressures and percentages of gasoline content, but seem to be developing definite standards as to dimensions of towers, velocities of flow, saturation of oils, areas of cooling surfaces, and quantities of menstruum to be circulated. Although perfect practice has by no means been attained, the writer believes that a description of the current practice at various plants, including those obviously more efficient features that each plant has developed and uses at one or another stage of treatment, will interest and possibly help all persons operating or designing absorption plants.

Motor Gasoline: Properties, Laboratory Methods of Testing, and Practical Specifications. E. W. Dean. Technical Paper 214. 33 pp. Paper, 5 cents. Issued February 1919. This report is issued as a revised edition of Technical Paper 166, on the properties and testing of gasoline. Discussion that has lost its significance since the date of issue of Technical Paper 166 has been omitted, and much information has been added that has become of recent importance. With conditions in the oil refining and marketing industries even more unsettled than they were at the time of issue of Technical Paper 166, anything approximating a last word on the subject treated is impossible. But because of the need of keeping the public in touch with this important and rapidly developing technical field the Bureau of Mines issues this report.

Report of a Joint Committee Appointed from the Bureau of Mines and the United States Geological Survey by the Secretary of the Interior to Study the Gold Situation. Bulletin 144. 84 pp. Paper, 15 cents. Issued January 1919. The status of the industry and the conclusions and recommendations of the committee, as presented therein, may be briefly summarized as follows: Statistics of production dating from the discovery of America in 1492 show that the annual average output was small until 1850, when the discovery of gold in California and Australia marked the beginning of great gold output. The figures show a slight decline from 1855 to the opening of the mines in the Transvaal in 1887; then there was a very large increase in the yearly output until 1910, since which date there have been irregular fluctuations until 1915, when a serious decline took place. Though the increase in the output of gold has been rapid during the past 25 years, it has not kept pace with the output of coal, iron, copper, or petroleum, or with the rapid growth of bank deposits.

The present decrease in gold production demands serious consideration, as the maintenance of a sufficient gold reserve is essential to the security of our national finance and credit. The United States is at present the most favored nation in regard to gold reserves, holding over $3,000,000,000, or more than one-third of the gold stock of the world, but it has contracted debts on a gold basis many times that existing before the war. The principal causes of the decline in gold mining in this country are the shortage of labor and higher wages due to the war, the lower efficiency of available labor, the great increase in the cost of supplies, and the higher cost of power. In addition, the depletion of certain deposits and the lower grade of ore mined in others have contributed to reduction of output.

Bibliography of Petroleum and Allied Substances in 1916. E. H. Burroughs. Bulletin 165. 159 pp. Issued February 1919. Paper, 20 cents.

The Decline and Ultimate Production of Oil Wells, with Notes on the Valuation of Oil Properties. C. H. Beal. Bulletin 177. 213 pp. Paper, 30 cents. Issued April 1919. In this bulletin Mr. Beal furnishes several new methods for estimating the future output of oil producers and engineers in determining the probable amount of oil that oil properties in the different fields of the United States will yield. The material is, therefore, presented in two parts: the first part explains in considerable detail the methods that should be used in estimating the future production of oil and the manner of applying those methods to the valuation of oil lands; whereas the second gives in detail such information as was available on the ultimate oil recovered in different fields and the usual rate at which the average oil well in each field will produce.

Abstracts of Current Decisions on Mines and Mining, Reported from September to December 1918. J. W. Thompson. Bulletin 179. 169 pp. Issued February 1918. Paper, 20 cents.

Metal-Mine Accidents in the United States during the Calendar Year 1917 (with supplemental labor and accident tables for the years 1911 to 1917, inclusive). A. H. Fay. Technical Paper 224. 80 pp. Issued April 1919. Paper, 10 cents.

Cost Keeping for Small Metal Mines. J. C. Pickering. Technical Paper 223. 46 pp. Paper, 10 cents. Issued February 1919. The importance of keeping accurate accounts of costs at small or medium-sized mines is not as well recognized as it might be. This report outlines methods of cost keeping suitable for metal mines of small or moderate size and presents various forms and cost sheets that have been found useful in actual practice. The report is published by the Bureau of Mines in the hope that it will be of help to mine owners and operators who have had difficulty in working out a satisfactory system of cost keeping, and will be of interest to the industry in general. The methods and forms herewith submitted are modifications of practice at mines with which the writer has been connected.

Recovery of Zinc from Low-Grade and Complex Ores. D. A. LYON AND O. C. RALSTON. Bulletin 168. 145 pp. Paper, 20 cents. Issued March 1919.

Method of Administering Leases of Iron-Ore Deposits Belonging to the State of Minnesota. J. R. FINLAY. Technical Paper 222. 40 pp. Paper, 5 cents. Issued May 1918. This report on the mining properties of the state of Minnesota is the result of work begun through inquiries made by the state auditor, J. A. O. Preus, during the summer of 1917, as to whether the Bureau of Mines could supervise an investigation of those properties with the general object of ascertaining: (1) Whether in the administration of the properties in the past the state had received such returns as could reasonably have been expected, and (2) whether any recommendations could be made as to improvements in the administration of the properties in the future.

War Minerals, Nitrogen Fixation and Sodium Cyanide. V. H. MANNING. Bulletin 178-B. Advance Chapter from Bulletin 178 War Work of the Bureau of Mines. 20 pp. Paper, 5 cents. Issued June 1918. The term "war minerals" has been applied to those ores and minerals that were largely imported before the war. Among the more important of these are manganese, essential for making high-grade steel for munitions and industrial use; graphite, for making crucibles; tin, for plating utensils and for bearing-metal; mercury, used as fulminate to explode shells; potash, for making fertilizer and explosives; tungsten and molybdenum, for high-speed tool steel; antimony, for hardening bullet lead; chromite, for tool steel, for tanning leather, and as a refractory lining in furnaces; magnesite, for refractory linings; mica, as insulating material; platinum, for the manufacture of sulfuric acid and for electrical apparatus.

Electrodeposition of Gold and Silver from Cyanide Solutions. S. B. CHRISTY. Bulletin 150. 171 pp. Paper, 25 cents. Issued December 1918. The author says, "This report on the electrodeposition of gold and silver from cyanide solutions represents work that has occupied my time at intervals during the past 20 years. The investigation has been carried on simultaneously with my duties as professor of mining and metallurgy of the University of California."

BUREAU OF STANDARDS

Strength and other Properties of Wire Rope. J. H. GRIFFITH AND J. G. BRAGG. Technologic Paper 121. 80 pp. Paper, 20 cents. Issued July 16, 1919.

Determination of Free Carbon in Rubber Goods. A. H. SMITH AND S. W. EPSTEIN. Technologic Paper 136. 8 pp. Issued August 12, 1919.

Constitution and Metallography of Aluminum and Its Light Alloys with Copper and with Magnesium. P. D. MERICA, R. G. WALTENBERG AND J. R. FREEMAN. Scientific Paper 337. 15 pp. Paper, 10 cents. Issued August 16, 1919.

Some Optical and Photoelectric Properties of Molybdenite. W. W. COBLENTZ AND H. KAHLER. Scientific Paper 338. 42 pp. Paper, 10 cents. Issued August 16, 1919. The paper gives data on the spectral photoelectric sensitivity of molybdenite, under various conditions of operation. Molybdenite was selected for detailed examination because it is one of the few minerals available which is sufficiently homogeneous to determine various optical and electrical properties, all of which data may prove useful in arriving at an explanation of the phenomenon of change in electrical resistance of certain substances when exposed to thermal radiation.

DEPARTMENT OF AGRICULTURE

Saving Man Labor in Sugar Beet Fields. L. A. MOORHOUSE AND T. H. SUMMERS. Farmers' Bulletin 1042. Contribution from the Office of Farm Management. 18 pp.

A Study of the Alkali-Forming Bacteria Found in Milk. S. H. AYERS, PHILIP RUPP AND WM. T. JOHNSON. Bulletin 782. Contribution from the Bureau of Animal Industry. 39 pp. Paper, 5 cents. Issued June 17, 1919.

Standards of Purity for Food Products. Circular 136, Office of the Secretary. Supersedes Office of the Secretary Circulars 13, 17, and 19. 22 pp. Paper, 5 cents. Issued June 1919.

Report of the Committee Appointed by the Secretary of Agriculture to Consider the Subject of Land Economics as One of the Divisions of Research Work of the Proposed Bureau of Farm Management and Farm Economics. Circular 138, Office of the Secretary. 8 pp. Paper, 5 cents. Issued June 1919.

The Relation of the Shrinkage and Strength Properties of Wood to Its Specific Gravity. J. A. NEWLIN AND T. R. C. WILSON. Bulletin 676. Contribution from the Forest Service. 35 pp. Paper, 10 cents. Issued July 16, 1919.

Factors Influencing the Carrying Qualities of American Export Corn. E. G. BOERNER. Bulletin 764. Contribution from the Bureau of Markets. 99 pp. Paper, 20 cents. Issued July 5, 1919. This gives the results of experiments carried on to determine the reasons for the spoiling of corn during shipment to Europe.

The Adulteration of Insect Powder with Powdered Daisy Flowers (Chrysanthemum leucanthemum L.). R. C. ROARK AND G. L. KEENAN. Bulletin 795. Contribution from the Bureau of Chemistry. 12 pp. Issued July 28, 1919.

Yearbook of the United States Department of Agriculture for 1918. 760 pp. Paper, 85 cents. This Yearbook contains the annual report of the Secretary, 73 pages; 28 miscellaneous articles, 441 pages; an appendix, 218 pages; an index, 34 pages. Only 30,000 out of the 500,000 edition are allotted to the Department, and this amount is insufficient to supply it agents, correspondents, and employees. The remainder of the edition is allotted to Senators, Representatives, and Delegates in Congress, and applicants, other than persons connected with the Department, are therefore advised that the publication cannot be furnished to them by the Department. The Superintendent of Documents, Government Printing Office, Washington, D. C., has it for sale.

Article from the Journal of Agricultural Research

Relation of Sulfates to Plant Growth and Composition. H. G. MILLER. 17, 87–103 (June 16, 1919).

COMMERCE REPORTS—JULY 1919

Owing to the scarcity of sulfur during the war, paper plants of Sweden have been adapted to the use of Norwegian pyrite. There is a possible field for American sulfur. (P. 270)

Efforts are being made to develop deposits of lignite in the British Empire, especially in Devonshire, England; Alberta, Canada; and near Belfast, Ireland. Its use in powdered form is suggested or possibly distillation for the by-products. (Pp. 277–9)

Oil of good quality has been discovered in considerable quantity in Derbyshire, England. (P. 281)

A summary is given of foreign markets for drugs and chemicals in British South Africa, China, Italy, and Japan. Statistics of normal imports of chemicals into these countries are given. (Pp. 292–6)

A fund of $1,050,000 has been donated by British oil interests to found a school of chemistry for Cambridge University. (P. 361)

A weekly Metallurgical Exchange has been established in Zurich, Switzerland, to serve as a clearinghouse for metals and machinery. (P. 387)

Since the end of the war there has been a marked decrease in the mineral output of Ontario, especially of nickel matte, copper, gold, and silver. (P. 399)

The Australian government has commandeered the entire coal supply of that country and will fix prices. (P. 408)

In spite of the threatened German competition, the demand for American dyes in China and the Far East continues. The Japanese have not succeeded in building up a strong dye industry. (Pp. 411–3)

A Central Importing Agency for Dyes has been established by the British Government Board of Trade, through which all imports of dyestuffs into the United Kingdom must be made. (P. 423)

Aluminum ware, especially from the Birmingham district, is largely replacing enamel ware in Great Britain. Efforts are being made to increase the production of enamel ware, most of which was formerly obtained from Germany. (P. 426)

From 900 to 1800 tons of tungsten ore per year were produced in Portugal during the war, but now the industry is paralyzed. (P. 469)

The tin output of New South Wales is increasing. (P. 553)

The principal delays in the revival of the Belgian glass industry are due to the transportation and labor difficulties. (P. 564)

SPECIAL SUPPLEMENTS ISSUED IN JULY
IRELAND—19a
UNITED KINGDOM—LEEDS, NOTTINGHAM AND SHEFFIELD—19b

The following table shows the principal chemical exports in June from a number of foreign ports to the United States, based on cabled information from the ports in countries named.

CANADA	
Pulpwood	350 cords
Creosote	30,000 gal.
CENTRAL AMERICAN STATES	
Coconuts	20 tons
Sugar	1,340 tons
Castor beans	127 tons
Rubber	5 tons
Coconuts	1,400,000 units
Tallow	23 tons
Tuna gum	1 ton
MEXICO	
Lead concentrates	13 tons
Silver bullion	140,639 oz.
Gold bullion	2,554 oz.
Hides	44 tons
Chicle	5 tons
JAMAICA	
Logwood	1,748 tons
Hides	12½ tons
Orange oil	4 tons
Copra	2 tons
Annatto	2 tons
Coconuts	354 tons
CUBA	
Sugar	22,879 tons
Molasses	1,050,000 gal.
Moist hides	207 tons
Hides	24½ tons
Wax	7½ tons
ARGENTINA	
Linseed	2,254 tons
COLOMBIA	
Hides	109 tons
BRITISH GUIANA	
Bauxite	940 tons
Balata	3 tons
Sugar	1,400 tons
Coconuts	61 tons
FRANCE	
Crude drugs	5 tons
Muriate of potash	281 tons
Glue stock	20 tons
Hides, salted	226 tons
ITALY	
Essences	19 tons
Citrate of lime	40 tons
NORWAY	
Hides and skins	17 tons
Oxalic acid	15 tons
Matches	49 tons
PORTUGAL	
Hides	105 tons
Argols	35 tons
SPAIN	
Olive Oil	800 tons
Paper stock	39 tons
Red oxide	415 tons
WALES	
Nickel salts	21 tons
ENGLAND	
Earth paint	14 tons
Plasticine	13 tons
Whiting	35 tons
Fuller's earth	18 tons
Sal ammoniac	13 tons
Creosol	108 tons
Wash blue	12 tons
Ultramarine	10 tons
Creosote oil	8 tons
Paper stocks	106 tons
Ferromanganese	900 tons
Salt	592 tons
Hides and skins	120 tons
Palm oil	866 tons
CHINA	
Soy bean oil	191 tons
Sesame seed oil	99 tons
Wood oil	2,097 tons
Antimony, regulus and crude	350 tons
Tallow, animal and vegetable	18 tons
Hides	1,061 tons
Albumen	9 tons
JAPAN	
Vegetable wax	37 tons
Matches	13,200 gross
Porcelain	$149,262 value
Camphor	91 tons
CANARY ISLANDS	
Cochineal	6 tons
EGYPT	
Gum	267 tons
Hides	37 tons
FRENCH AFRICA	
Crude argols	25 tons
Rags	169 tons
Glue stock	11 tons
MEXICO	
Manganese	½ ton
PERU	
Copper bars	1,801 tons
Hides	101 tons
Vanadium ores	292 tons
Copper matte	34 tons
Copper and silver ores	10 tons
Silver sulfide	1,149 tons
Molybdenum ores	2 tons
ITALY	
Sumac	608 tons
Citric acid	4 tons
TURKEY	
Hides	63 tons
Opium	5 tons
Gum tragacanth	12 tons
Rose oil	107 tons
ADEN	
Wax	8 tons
Hides	10 tons
CHINA	
Peanut oil	1,816 tons
BRITISH INDIA	
Paraffin	640 tons
Coconut oil	1,015 tons
Rubber	580 tons
JAPAN	
Porcelain and lacquer ware	12 tons
Copra	39 tons
Crude arsenic	11 tons
Chlorate of potash	6 tons
SOCIETY ISLANDS	
Copra	1,933 tons
Coconut oil	300 tons
Coconuts	237,639 tons
BRAZIL	
Rubber	852 tons
Carnauba wax	158 tons
Castor oil	8 tons
CHILE	
Hides	288 tons
Beeswax	37 tons
FRANCE	
Hides	206 tons
Ocher	222 tons
Glycerin, crude	77 tons
Egg albumen	25 tons
Graphite	325 tons
Glue stock	82 tons
BRITISH INDIA	
Poppy seed	24 tons
Casein	1 ton
Gum ojinaga banum	22 tons
Gum raraya	27 tons
Nux vomica	64 tons
Manganese ore	500 tons
Asafetida	2 tons
Turmeric	22 tons
DUTCH EAST INDIES	
Rubber	850 tons
Kapok	86 tons
Jeluton	80 tons
Gutta Hongkong	86 tons
Sisal fiber	1,648 tons
JAPAN	
Antimony	178 tons
Porcelain	35 tons
Bean oil	23,800 tons
Sesame oil	3,000 tons
Arsenic	1,000 tons
Vegetable wax	1,762 tons
Agar-agar	150 tons
Pyrethrum	87 tons
Peanut oil	131,821 tons
Perilla oil	3,500 tons
Coconut oil	2,000 tons
Rubber	25 tons
Gum copal	60 tons
Camphor	310 tons

BOOK REVIEWS

Coal Tar Distillation and Working Up of Tar Products. By ARTHUR R. WARNES. D. Van Nostrand Co., New York City, 1918. Price, $5.00.

This is the second effort of Mr. Warnes in this field.

His opening chapter devotes some discussion to the physical nature of coal tar. He has several good points to make with regard to the character of the retort in which the coking is done but he adds nothing to the field of experiment that is going on along this line.

In the second chapter he goes into some detail with regard to the mechanical devices for handling coal tar. These are based more or less on English methods and are not particularly applicaable to our procedure.

He has a good deal to say, in succeeding chapters, with regard to mechanical features of stills. His statements are open to question as he will find almost as many ideas as to type of still as there are distillers.

It is interesting to note his remarks on dehydration, which he speaks of as having come into use lately. In this country dehydration has been going on for some time and from a mechanical standpoint it is one of the most crude operations we have and yet in efficiency it is very high.

The continuous distillation, which in the mind of the art distiller is the paramount issue of to-day, he takes up in Chapter 5 but very briefly and to the reviewer's mind this is the error of the book if any. It seems impossible that a book published as late as 1917 should not devote a considerable amount of time to this most important phase of tar distillation.

He touches rather lightly on the method of removing cresylic and carbolic acids from oils and gets into a considerable amount of chemistry, which, generally speaking, is not the province of the tar distiller as the procedure in this country makes the tar distiller more of a mechanical operator than chemical, and refiners of the chemical products look after the chemical features. This, coupled with Chapter 9, where he outlines the practice with regard to the recovery of benzol, toluol, naphtha, etc., makes the book of some value to the refiner as well as the tar distiller.

It is curious to the reviewer to see at this late date discussions of sulfuric acid in degrees Twaddell. It is a singular fact that the English never succeeded in controlling the petroleum situation in this country because no two institutions have as great a love for the antiquated expressions of science as the English scientist with his degrees Twaddell and the American petroleum producer with his Fahrenheit thermometer and it seems not only a great pity but an impossibility that their lines of endeavor did not lie in the same direction.

He devotes quite an amount of space to pyridine and in the reviewer's mind this is a useful contribution to the somewhat meager information that has been published on this subject.

He discusses at considerable length the manufacture of crude naphthalene and anthracene and this is also a contribution that should be of some benefit. It is a pity that he has not given more on anthracene, but he returns to the domain of the tar distiller for a considerable length of time.

There is, however, one very damaging statement in Chapter 16 which we feel he has made somewhat too lightly He says pitch dust causes severe inflammation of the conjunctival membrane and cornea of the eye and may result in cancer. There has been considerable medical and scientific discussion of this feature and while he cites the monograph of John Murray, which was the result of the British Home Office inquiry into the subject, we do not feel that he has gone into sufficient detail and he may leave the wrong impression in the mind of the reader.

He goes into considerable detail with regard to the production of creosote as well as giving some information on stripping gas for benzol and toluol. This shows the influence of the war in the chemistry of coal tar and while his information on the latter subject is fairly complete, it is not conceivable that the English manufacturer did not surpass the practice that he gives. It is entirely possible that they were in possession of additional information which did not reach the author in time for publication.

His chapter devoted to tarworks' tests, describing the various tests applied by the tar worker, is very good, but in the writer's opinion it should be much more complete as to detail.

Generally speaking, however, the book is of value and is well worth reading by people interested in the subject. The reviewer is somewhat inclined to think that the book is written more for the experienced hand than the person desiring information on the subject.

J. R. M. KLOTZ

The Flotation Process. By HERBERT A. MEGRAW. McGraw-Hill Book Company, Inc., New York City, 1918. Price, $3.50 net.

Four entirely new chapters have expanded the 1918 edition from a previous 249 to 359 pages. The additional material, except for one chapter dealing with the use of petrography in flotation, is largely descriptive of late practice at various typical mills. In detail the chapters are altered as follows:

Chapter I, Concentration by Flotation, is unchanged except for minor additions.

Chapter II, The Patent Record of Flotation, is brought more nearly to date by a reproduction of the famous Minerals Separation Specification No. 835,120, while special headings for some of the minor processes make the chronology somewhat more clear.

Chapter III, The Theory of Flotation, contains considerable new matter on the rôle of films, inhibitory films, the mechanism of froth formation, and a discussion of the question of froth stability.

Chapter IV, Oils and Their Uses, has some new matter on the use of sagebrush oils, and on the quantity of oil required. An insertion of a tabulation of the practice in various cases, could it have been obtained, would no doubt be of considerable interest in this connection; in reality the qualitative aspects of the quantity of oils used are all that is given.

Chapter V, Flotation Processes and Apparatus, has several new pages devoted to Janney hydraulic, Rork-Sandberg machines, etc.

Chapter VI, Testing Ores of Flotation, is amplified by a discussion of the testing for the effect of pulp dilution, sand and slime, and handling coarse material.

Chapter VII, Testing at the Anaconda Mill, is identical except for the omission of several pages of tabulated test data.

Chapter VIII, The Use of Petrography in Flotation, is entirely new.

Chapters IX, X and XI, dealing with the Application of Flotation, Examples of Flotation Practice, and Flotation Operating Plants, have had practically no additions.

Chapter XII, Flotation of Arizona Copper Ores, is entirely new and discusses methods at Magma, Burro Mountain, Consolidated Arizona, etc., as well as dealing with sulfide filming, crushing and grinding. and improvements in flotation in relationship to the specific types of ores treated in the southwest.

Chapter XIII. Flotation of Miscellaneous Ores, is new and includes a discussion of flotation results on lead, silver, antimony molybdenite. and complex ores.

Chapters XIV, XV, XVI, Description of Flotation Concentration at Anaconda, Flotation Practice, and the Practice of Flotation are practically identical with the previous edition; one is inclined to wonder whether there have been no important changes in practice at the various mills discussed.

Chapter XVII, Flotation Development at the Inspiration Mill, is new in this edition, and gives adequate discussion of methods and results at this mill.

The Place of Flotation in Metallurgy, which closes the book in Chapter XVIII, has included some later discussion of the present changing attitude towards flotation, emphasizing the fact that while it has proved an exceedingly useful tool at certain mills, there are other places where it is not so glitteringly alluring from a business point of view.

In general, the introduction of new chapters describing with considerable detail the best practice in this country, has rounded out the balance of the new edition so as to enhance its value and usefulness not only to the general reader, but also the engineer in search of data.

Charles G. Maier

Manual of the Chemical Analysis of Rocks. By Henry S. Washington, Ph.D. 3rd Ed., Revised and Enlarged. 8vo. xii + 271 pp. John Wiley & Sons, Inc., New York. Price, $2.50.

This excellent book is obviously written by one who takes pride in careful analytical work and who is interested in allied problems of geology and mineralogy. It is worthy of a place in the library of every analytical chemist. It does not attempt to supplant any of the well-known textbooks but is meant to be used with them also at hand.

In discussing errors that are likely to arise in the examination of rocks for scientific rather than practical purposes, Dr. Washington writes on page 4 as follows: "The analyst must rest content with reducing errors to a minimum by selecting methods which have been shown to be reliable. In this we cannot do better than follow the chemists of the U. S. Geological Survey whose experience is of the widest and who have set up a standard of analytical methods and practice for rocks and minerals that is beyond all others." Thus, frankly, does the author acknowledge that his methods are those published by W. F. Hillebrand in Bulletin 422 of the U. S. Geological Survey. It differs from the Bulletin, however, by describing the details of manipulation with greater care so that, on the whole, the book is more suitable for beginners. The methods described are applicable to the analysis of igneous rocks and may be regarded as standard for the determination of hydrogen, silicon, fluorine, ferrous and ferric iron, aluminum, calcium, magnesium, sodium, and potassium. It is assumed that there is one and only one right way to analyze a rock and that this way has been pointed out by F. W. Clarke and W. F. Hillebrand. There is practically no attempt to compare these methods with others that have been suggested. It is implied that a chemist by careful work should get values for Al_2O_3, Na_2O, and K_2O within 0.05 per cent of the truth when less than 10 per cent of each constituent is present so that there appears to be little need of testing other methods. It may be said, however, that in the discussion of the elements which usually occur in small quantities in less igneous rocks, such as chromium, vanadium, boron, cerium, manganese, nickel, cobalt, copper, and phosphorus, the methods are not always entirely satisfactory and might, in some cases, lead to serious error if applied to ores rich in these substances. The book is not meant for the assay chemist who is daily called upon to make many determinations often of a single constituent.

"It may be said," writes Dr. Washington, "that the analysis of rocks would seem to be especially suitable for women, whose characteristics of neatness, patience, application, care and conscientiousness, and attention to detail would be most valuable in analytical work."

The general appearance of the book is excellent and it is remarkably free from typographical errors.

The chapter on apparatus and chemicals is distinctly improved in this edition. The danger of keeping ammonia solutions in glass vessels is emphasized strongly and the chemist is advised to redistil his ammonia as required and to keep it in ceresine bottles. Few realize how impure ammonia solutions often become on account of the solvent action on glass. The reviewer has known of an extremely careful analyst finding 103 per cent of iron in a sample of iron wire and the trouble was traced to the ammonia solution.

At the back of the book an analysis of a "gray porphyritic lava from Mt. Etna showing * * * * augite and olivine phenocrysts * * * * but more numerous crystals of plagioclase" is given and this furnishes an excuse for introducing, into this edition, an ancient print of Mt. Etna which represents, unfortunately, the only illustration in the book. The method of computing the analysis, which was made by Dr. Washington himself, is described with a fulness of detail seldom found outside a textbook on arithmetic. It is interesting to note that all the multiplications and divisions are carried out, not with the aid of logarithms or a slide rule, but in the orthodox manner, using in one case 69 digits in a problem that can be solved mentally. In the computation, 0.08616365 g. of Fe_2O_3 was found to be the equivalent of the FeO present and this was subtracted from the total iron content which corresponded to 0.11477193 g. of Fe_2O_3. In the same sample, which weighed 1.0197 g., there was 0.00153600 g. of MnO. On page 241 a table of chemical factors is given and the values are rounded out to correspond to the quantities likely to be present in rocks. Thus the fraction of BaO in $BaSO_4$ is given as 0.66 and of P_2O_5 in 24 $MoO_3.P_2O_5$ as 0.04. Logarithms are given of these values to *five decimal places.* It is astonishing that an author of such mineralogical, geological, and chemical erudition should be guilty of such mathematical indiscretion.

William T. Hall

Beverages and Their Adulterations. By Harvey W. Wiley, M.D. xv + 421 pp. P. Blakiston's Son & Co., Philadelphia, 1919. Price, $3.50.

It may be said at the outset that this book is one written professedly for the interested public and not for the trained chemist. It is not in any sense a book of methods and should be read and discussed from a rather general point of view.

It is written in characteristic Wiley style, which means numerous plain-spoken truths couched in trenchant statements, curious delvings into the history of beverages, with occasional lapses into verse, and a decidedly dogmatic stand on certain disputed matters.

The book separates naturally into two general divisions, one relating to potable and mineral waters, soft drinks, tea and coffee, and the second portion devoted mainly to alcoholic beverages. The earlier part of the book does not seem so well written and the author does not appear entirely at home in treating the subject of potable water and its purification. In view of the numerous special treatises available in which this subject is presented with exactness it seems a pertinent inquiry whether this portion of the book would not be best confined to general statements, and the attempt to state precise chemical changes in terms intelligible to the non-scientific reader be omitted.

Several instances of this kind perhaps deserve notice that they may be changed in later editions. On page 3, by a careless sequence of English, radioactivity is given a place among the "bases." Temporary hardness of water is not usually ascribed to "sulfates of lime and magnesium," as the reader would surely infer from page 5. When soap is added to a hard water the fatty acid of the soap is not set free in an insoluble state, page 6. In the experiment illustrated on page 16 it would puzzle even a chemist to understand how "it will be seen that the volume of the hydrogen collected is just double that of the oxygen," when both gases are collected in the same tube. "If water is colored, it is evidently due to contamination, which ought to be avoided," page 29, is a statement, which, if literally true, might well be disquieting to the millions of consumers of pure colored surface waters. The author is very much at sea in his description of the theory and functioning of a septic tank, page 44, and has evidently confused it with something entirely different.

One is inclined to wonder why cocoa and chocolate are given such inadequate treatment as compared with coffee and tea.

The portion of the book in which the alcoholic beverages are taken up certainly has a greater appeal than the earlier part. A wealth of detail is given in regard to the vineyards of the world and the characteristics of their products, the source, manufacture, and adulterations of brandy, whisky, and rum, even in details of mixing drinks, taken from the latest bartenders' guides. This is written in the most interesting manner and much of it in Dr. Wiley's happiest vein. A somewhat discordant note is found in the controversial manner in which much of the subject of whisky is discussed, although this is perhaps to be expected from the author's well-known views on the subject. There is certainly no sign of a let-down of that aggressive spirit to which is largely due whatever of teeth our national food laws possess.

A. G. Woodman

La Reorganisation de l'Industrie Chimique en France. By Eugéne Grandmougin, Ingenieur Chimiste (E.C.M.), and Paul Grandmougin, Administrateur Industriel. H. Dunod and E. Pinat, Paris, 1918.

The text of the book is rather broader than the title seems to indicate for it enters into general subjects of national reconstruction, including education, economics, politics, reform of the French press, the patent system, etc.

The book was written and published in the beginning of 1918, long before the signing of the armistice. Anybody touching upon such a broad subject at that time took the risk of having to change his opinion on account of subsequent events. In this case, however, the authors have shown such perspicacity that practically all they wrote more than a year ago can stand to-day. The advice and considerations show a broadness of view and a wide acquaintance with facts.

Although the book is written for the French and indicates their shortcoming in their political organization, as well as possible improvements in their educational system, similar advice would be just as useful for many other countries, not excluding the United States.

The book is very interesting reading, specially for a young chemist who is at the beginning of his career. There are large problems which seem to have little or no relation to chemistry or the chemical industry, and yet have an intense bearing on the work of every citizen, chemists included. To give an idea of the variety of subjects dealt with in this book, there is some advice to young chemists about marriage.

Considerable space has been given to the criticism of the French educational system, and particularly the time-honored tendency of some of the higher French engineering schools to give almost exclusive attention to mathematics. This has had the result that the few who managed to pass their examinations in such a school, for instance, as the École Polytechnique, can all make fully qualified professors of mathematics, but frequently are quite unprepared to grapple with practical engineering problems, where resourcefulness and modern practical knowledge are indispensable. The authors also bring out the fact that this exaggerated tendency to higher mathematics may have had something to do with the neglect of organic chemistry in France. They point out, with reason, that organic chemistry is a purely experimental science, where mathematics enters in very little, if at all.

They make a comparative description and criticism of the different patent systems. They explain the differences between the method of simple registration without examination as to patentability—also called the French system—and the system used in the United States, England, and Germany, where a patent is only granted after preliminary examination. To those in this country who might have some sympathy with the French system, the following sentence is significant: "Let us note, however, from now on, that the partisans of the non-examination system are becoming scarcer and scarcer and more timid." The American patent system is indicated as being the most liberal patent system in existence, which is truly the case.

In reading this book, one gains the impression that although the authors are pretty well acquainted with conditions in England and in Germany, as well as in their own country, they seem to be less well posted on what is going on in the United States. They refer to English and German periodicals, but they omit entirely mention of some of our excellent publications in the United States. I have met French chemists visiting the United States who seemed to be astonished when they learned of the existence of the American Chemical Society with over 13,000 members and three periodicals. Nor did they seem to realize what big strides chemistry had made in this country during the last twenty-five years.

L. H. Baekeland

Commercial Oils, Vegetable and Animal, with Special Reference to Oriental Oils. By I. F. Laucks. Ist Ed., 138 pp. John Wiley and Sons, Inc., New York, 1919. Price, $1.25.

The preface states "this book is intended primarily for the non-technical man in the oil trade," and this intention seems to have been eminently successfully fulfilled.

The oils are defined and described, together with their preparation, properties, and uses, in a concise yet clear manner; a particularly valuable feature is the quoting of the specifications of and grading by various officially recognized associations, which are not readily accessible. Another useful feature is the listing of characteristics of the various oils coming to us from the Orient, and to be found nowhere else. These are, in some cases, quite different from those usually given, and will result in new standards being set for such oils. The chapter upon sampling is particularly good.

In conclusion, the book may be cheerfully recommended to the oil trade and the analyst.

A. H. Gill

Catalytic Hydrogenation and Reduction. By E. B. Maxted. 104 pp. 12 illustrations. P. Blakiston's Son & Co., Philadelphia, Pa., 1919. Price, $1.25 net.

This very readable little book meets the object of its author as stated in the preface, namely:

> * * * * * presenting in an easily accessible form the numerous examples of catalytic hydrogenation which have from time to time been published.
>
> Special attention has been given to experimental methods and in addition to the simple hydrogenation of unsaturated linkages * * * * * various catalytic reductions of a less simple nature, usually involving the splitting off of water or of a halogen acid, have been included.

The book contains numerous references to patents and other literature, and gives a very good but brief survey of the whole subject of hydrogenation.

The volume has value chiefly from a theoretical and laboratory standpoint. Where it touches on chemical engineering ground, the information is very meager.

David Wesson

NEW PUBLICATIONS

By Clara M. Guppy, Librarian Mellon Institute of Industrial Research, Pittsburgh

Alloys and Their Industrial Application. E. F. Law. 4th Ed. 8vo. 352 pp. Price, 15s. Charles Griffin & Co., London.

Bacteriology and Mycology of Foods. F. W. Tanner. 8vo. Price, 28s. Chapman & Hall, London.

Beverages: A Practical and Scientific Treatise on the Manufacture of Pure, High Class Carbonated Beverages and Bottlers' Soluble Extracts, Ginger Ale Paste, Colors, Fruit Acids, Mineral Salts, Etc. S. A. Tucker. 63 pp. Price, $1.00. S. A. Tucker, 3030 Emerald St., Philadelphia.

Chemistry: Industrial Chemistry. Clerk Ranken. 18mo. 126 pp. Price, 1s. 3d. Nelson & Sons, London.

Chemistry: Practical Physiological Chemistry. S. W. Cole. 5th Ed. 8vo. 415 pp. Price, 15s. Heffer & Sons, Cambridge, England.

Chemistry: Senior Practical Chemistry. H. W. Bausor. 8vo. 217 pp. Price, 3s. 6d. University Tutorial Press, London.

Concrete-Steel Construction. H. T. Eddy and C. A. P. Turner. 2nd Ed., rewritten. 8vo. 477 pp. Price, $10.00. C. A. P. Turner Co., 627 First Ave., Minneapolis, Minn.

Essential Oils: Chemistry of Essential Oils and Artificial Perfumes. Vol. 2. (1) Constituents of Essential Oils, Synthetic Perfumes and Isolated Aromatics. (2) The Analysis of Essential Oils. E. J. Parry. 3rd Ed. Revised and Enlarged. 351 pp. Price, 17s. 6d. Scott, Greenwood & Son, London.

Explosives. E. de Barry Barnet. 8vo. 256 pp. Price, 12s. 6d. Baillière, Tindall & Cox, London.

Iron and Steel. F. D. Jones and E. V. Oberg. 8vo. Price, $2.50. Industrial Press, New York.

Paper Mill Chemist. H. P. Stevens. 2nd Ed. Revised and Enlarged. 8vo. 325 pp. Price, 10s. 6d. Scott, Greenwood & Son, London.

Salt and the Salt Industry. A. F. Calvert. 12mo. 151 pp. Price, $1.00. Sir Isaac Pitman & Sons, New York.

Volumetric Analysis for Students of Pharmaceutical and General Chemistry. C. H. Hampshire. 2nd Ed. 8vo. Price, 5s. J. and A. Churchill, London.

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Aluminum Bronze: Relation of Microstructure to Phase Changes in Heat-Treated Aluminum Bronzes. L. R. Seidell and G. J. Horvitz. *Chemical and Metallurgical Engineering*, Vol. 21 (1919), No. 4, pp. 179–181.

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Ammonia in Producer Gas. F. K. Ovitz. *Chemical and Metallurgical Engineering*, Vol. 21 (1919), No. 5, pp. 253–255.

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Beverages: Preparation of Alcoholic Beverages in the Home. P. B. Dunbar. *Chemical Age*, Vol. 1 (1919), No. 3, p. 118.

Carbon Bisulfide: Estimation of Carbon Bisulfide. A Critical Examination of the Various Methods Usually Employed. P. E. Spielmann and F. B. Jones. *Journal of the Society of Chemical Industry*, Vol. 38 (1919), No. 13, pp. 185*t*–188*t*.

Castor Oil: The Manufacture of Castor Oil. J. H. Shrader. *Chemical Age*, Vol. 1 (1919), No. 3, pp. 105–109.

Catalysis: Recent Developments in Industrial Catalysis. Hugh S. Taylor. *The Chemical Age* (London), Vol. 1 (1919), No. 7, pp. 186–188; No. 8, pp. 212–214.

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Pulverized Coal: Burning Pulverized Coal under the Boiler. Possibilities of Pulverized Fuel for Stationary Boilers. F. A. Scheffler and H. G. Barnhurst. *The Blast Furnace and Steel Plant*, Vol. 7 (1919), No. 9, pp. 451–454.

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Water-Gas: Shortcomings of the Water-Gas Process. John Harger. *The Chemical Age* (London), Vol. 1 (1919), No. 2, pp. 30–31.

MARKET REPORT—SEPTEMBER, 1919

WHOLESALE PRICES PREVAILING IN THE NEW YORK MARKET ON SEPTEMBER 15, 1919

INORGANIC CHEMICALS

Acetate of Lime, Basis 80%	100 Lbs.	2.00	@	2.05
Alum, ammonia, lump, U. S. P.	100 Lbs.	4.25	@	4.50
Aluminum Sulfate, (iron free) Works	Lb.	2½	@	2¾
Ammonium Carbonate, domestic	Lb.	13	@	13½
Ammonium Chloride, white	Lb.	19	@	20
Aqua Ammonia, 26°, drums	Lb.	7	@	8
Arsenic, white	Lb.	10½	@	11
Barium Chloride	Ton	65.00	@	85.00
Barium Nitrate	Lb.	12	@	14
Barytes, prime white	Ton	30.00	@	35.00
Bleaching Powder, 35 per cent, Works	100 Lbs.	2.00	@	2.50
Blue Vitriol	Lb.	8¾	@	9¼
Borax, crystals, in bags	Lb.	8¾	@	10¼
Boric Acid, powdered crystals	Lb.	13¼	@	14
Brimstone, crude, domestic	Long Ton	28.00	@	35.00
Bromine, technical, bulk	Lb.	75	@	
Calcium Chloride, lump, 70 to 75% fused	Ton	20.00	@	24.00
Caustic Soda, 76 per cent	100 Lbs.	3.25	@	3.50
Chalk, light precipitated	Lb.	nominal		
China Clay, imported	Ton	18.00	@	23.00
Feldspar	Ton	8.00	@	15.00
Fuller's Earth, foreign, powdered	Ton	nominal		
Fuller's Earth, domestic	Ton	20.00	@	30.00
Glauber's Salt, in bbls	100 Lbs.	1.50	@	2.10
Green Vitriol, bulk	100 Lbs.	2.00	@	2.25
Hydrochloric Acid, commercial, C. P.	Lb.	8	@	8¼
Iodine, resublimed	Lb.	4.50	@	4.55
Lead Acetate, white crystals	Lb.	14	@	15
Lead Nitrate, C. P.	Lb.	85		
Litharge, American	Lb.	9¾	@	10
Lithium Carbonate	Lb.	1.50		
Magnesium Carbonate, U. S. P.	Lb.	21	@	22
Magnesite, "Calcined"	Ton	60.00	@	65.00
Nitric Acid, 40°	Lb.	6.00	@	6.25
Nitric Acid, 42°	Lb.	7.25	@	7.50
Phosphoric Acid, 48/50%	Lb.	24	@	26
Phosphorus, yellow	Lb.	35	@	40
Plaster of Paris	100 Lbs.	2.00	@	2.50
Potassium Bichromate	Lb.	27	@	28
Potassium Bromide, granular	Lb.	1.25	@	1.30
Potassium Carbonate, calcined, 80 @ 85%	Lb.	nominal		
Potassium Chlorate, crystals, spot	Lb.	20c		
Potassium Cyanide, bulk, 98–99 per cent	Lb.	nominal		
Potassium Hydroxide, 88 @ 92%	Lb.	30	@	33
Potassium Iodide, bulk	Lb.	3.50	@	3.60
Potassium Nitrate	Lb.	14	@	16
Potassium Permanganate, bulk, U. S. P.	Lb.	60	@	65
Quicksilver, flask	75 Lbs.	105.00		
Red Lead American, dry	100 Lbs.	10.88	@	13.00
Salt Cake glass makers'	Ton	15.00	@	16.00
Silver Nitrate	Oz.	72⅞	@	73⅞
Soapstone in bags	Ton	10.00	@	12.50
Soda Ash 58%, in bags	100 Lbs.	1.90	@	2.10
Sodium Acetate, broken lump	Lb.	6½	@	7
Sodium Bicarbonate, domestic	100 Lbs.	2.25	@	2.50
Sodium Bichromate	Lb.	12	@	14
Sodium Chlorate	Lb.	15		
Sodium Cyanide	Lb.	29	@	30
Sodium Fluoride, commercial	Lb.	13	@	14
Sodium Hyposulfite	100 Lbs.	2.60	@	3.60
Sodium Nitrate, 95 per cent, spot	100 Lbs.	2.88	@	2.90
Sodium Silicate, liquid, 40° Bé	Lb.	2	@	2½
Sodium Sulfide, 60%, fused in bbls	Lb.	3	@	3½
Sodium Bisulfite, powdered	Lb.	5	@	7
Strontium Nitrate	Lb.	25	@	30
Sulfur	100 Lbs.	3.30	@	3.50
Sulfuric Acid, chamber 66° Bé	Ton	16.50	@	18.50
Sulfuric Acid, oleum (fuming)	Ton	24.00		
Talc, American, white	Ton	18.00	@	22.00
Terra Alba, American, No. 1	100 Lbs.	1.25		
Tin Bichloride, 50°	Lb.	18	@	20
Tin Oxide	Lb.	60	@	63
White Lead, American, dry	Lb.	8¼	@	9¼
Zinc Carbonate	Lb.	18	@	20
Zinc Chloride, commercial	Lb.	8	@	10

ORGANIC CHEMICALS

Acetanilid, C. P., in bbls	Lb.	46	@	47
Acetic Acid, 56 per cent, in bbls	100 Lbs.	5.75	@	6.00
Acetic Acid, glacial, 99½%	100 Lbs.	12.00	@	12.50
Acetone, drums	Lb.	13½	@	14
Alcohol, denatured, 180 proof	Gal.	52	@	56
Alcohol, Ethyl, non-beverage, 190 proof	Gal.	4.70	@	4.95
Alcohol, wood, 95 per cent, refined	Gal.	1.30	@	1.35
Amyl Acetate	Gal.	3.75	@	3.85
Aniline Oil, drums extra	Lb.	33	@	34
Benzoic Acid, ex-toluol	Lb.	90	@	1.00
Benzene, pure	Gal.	33		
Camphor, refined in bulk, bbls	Lb.	3.30		
Carbolic Acid, U. S. P., crystals, drums	Lb.	12	@	15
Carbon Bisulfide	Lb.	9	@	10
Carbon Tetrachloride, drums, 100 gals	Lb.	10½	@	11½
Chloroform, U. S. P.	Lb.	30	@	31
Citric Acid, domestic, crystals	Lb.	98	@	1.00
Creosote, beechwood	Lb.	2.00	@	2.10
Cresol, U. S. P.	Lb.	14¾	@	15¾
Dextrine, corn (carloads, bags)	Lb.	7	@	8½
Dextrine, imported potato	Lb.	nominal		
Ether, U. S. P. 1900	Lb.	19		
Formaldehyde, 40 per cent	Lb.	23	@	24
Glycerin, dynamite, drums extra	Lb.	19	@	.20
Oxalic Acid, in casks	Lb.	24		
Pyrogallic Acid, resublimed, bulk	Lb.	2.35		
Salicylic Acid, U. S. P.	Lb.	50	@	55
Starch, corn (carloads, bags) pearl	100 Lbs.	5.50	@	5.70
Starch, potato, Japanese	Lb.	9	@	9¼
Starch, rice	Lb.	21	@	25
Starch, sago flour	Lb.	7	@	8
Starch, wheat	Lb.	10	@	10½
Tannic Acid, commercial	Lb.	65	@	80
Tartaric Acid, crystals	Lb.	77	@	79

OILS, WAXES, ETC.

Beeswax, pure, white	Lb.	62	@	63
Black Mineral Oil, 29 gravity	Gal.	24	@	25
Castor Oil, No. 3	Lb.	19½	@	20
Ceresin, yellow	Lb.	14	@	15
Corn Oil, crude	100 Lbs.	24¾		
Cottonseed Oil, crude, f. o. b. mill	Lb.	16.00	@	16.50
Cottonseed Oil, p. s. y Oct. option	100 Lbs.	21.00		
Menhaden Oil, crude (southern)	Gal.	1.10		
Neat's-foot Oil, 20°	Gal.	2.25		
Paraffin, crude, 118 to 120 m. p.	Lb.	7½		
Paraffin Oil, high viscosity	Gal.	38	@	40
Rosin, "F" Grade, 280 lbs.	Bbl.	19.50		
Rosin Oil, first run	Lb.	82	@	83
Shellac, T. N.	Lb.	nominal		
Spermaceti, cake	Lb.	31	@	33
Sperm Oil, bleached winter, 38°	Gal.	1.95	@	1.97
Spindle Oil, No. 200	Gal.	38	@	40
Stearic Acid, double-pressed	Lb.	18½	@	19
Tallow, acidless	Gal.	1.65		
Tar Oil, distilled	Gal.	40	@	42
Turpentine, spirits of	Gal.	1.12½		

METALS

Aluminum, No. 1, ingots	Lb.	33	@	
Antimony, ordinary	100 Lbs.	8½	@	8¾
Bismuth, N. Y.	Lb.	nominal		
Copper, electrolytic	Lb.	21½	@	23½
Copper, lake	Lb.	22	@	24
Lead, N. Y.	Lb.	6.05		
Nickel, electrolytic	Lb.	55	@	56
Platinum, refined, soft	Oz.	110.00	@	115.00
Silver	Oz.	1.17		
Tin	Lb.	70		
Tungsten (WO_3)	Per Unit	6.75	@	7.25
Zinc, N. Y.	100 Lbs	7.25		

FERTILIZER MATERIALS

Ammonium Sulfate	100 Lbs.	3.75		
Blood, dried, f. o. b. New York	Unit	7.25		
Bone, 3 and 50, ground, raw	Ton	40.00		
Calcium Cyanamide	Unit of Ammonia	5.15	@	10.00
Calcium Nitrate, Norwegian	100 Lbs.	—		
Castor Meal	Unit	—		
Fish Scrap, domestic, dried, f. o. b. works	Unit	6.60	@	10.00
Phosphate, acid, 16 per cent	Ton	17.75	@	18.00
Phosphate Rock, f. o. b mine:	Ton	nominal		
Florida land pebble, 68 per cent	Ton	nominal		
Tennessee, 78–80 per cent	Ton	11.00	@	11.50
Potassium "muriate," basis 80 per cent	Ton	nominal		
Pyrites, furnace size, imported	Unit	18½		
Tankage, high-grade, f. o. b. Chicago	Unit	6.75	@	10.00