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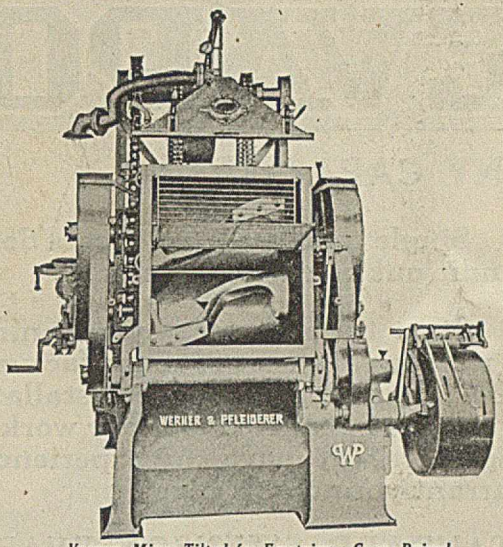

Vacuum Mixer Tilted for Emptying—Cover Raised

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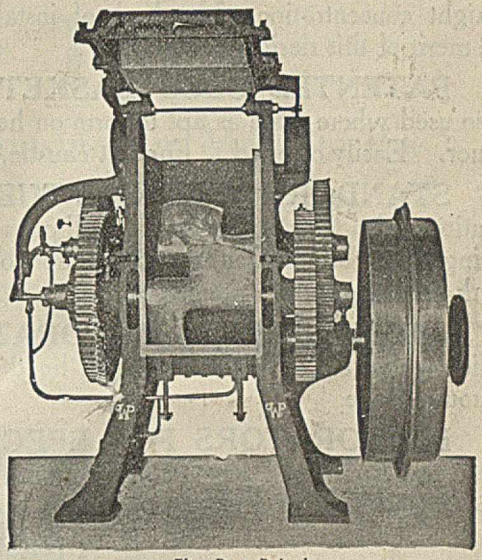
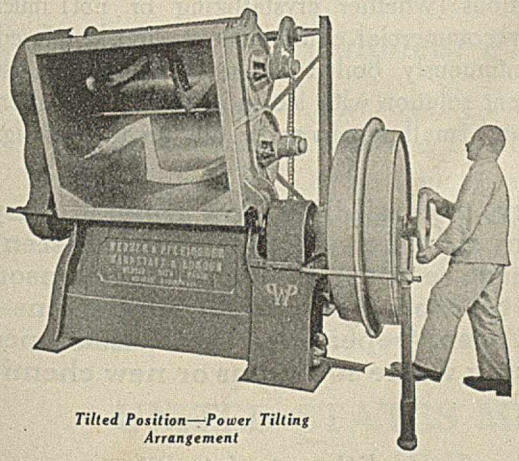
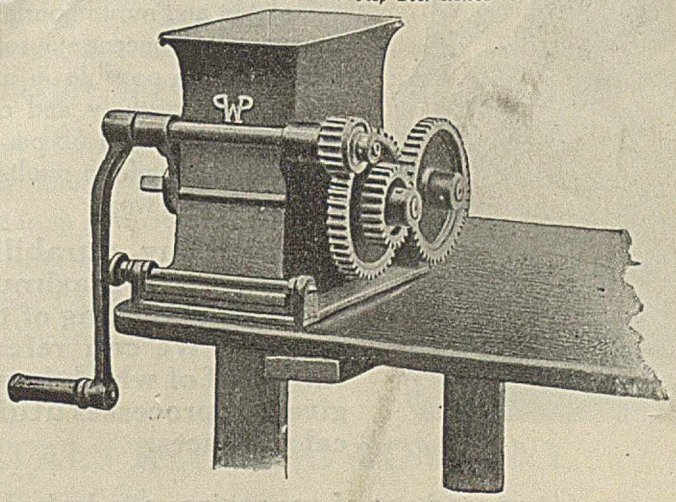

Flap Door Raised


Tilted Position—Power Tilting Arrangement



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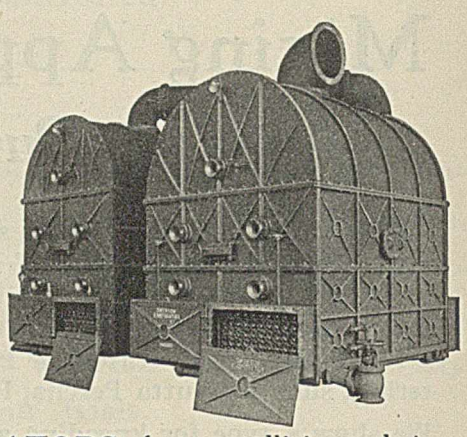

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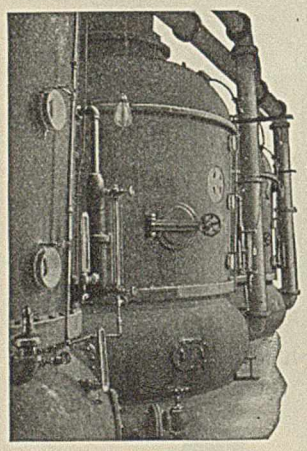

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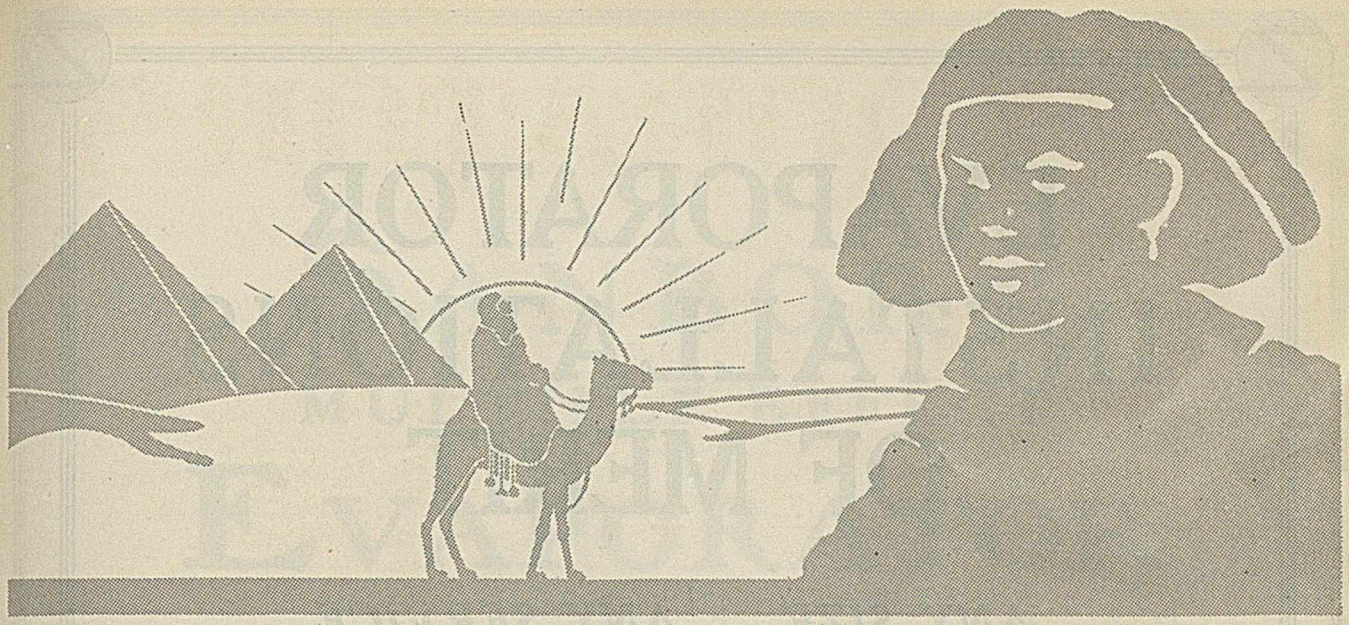

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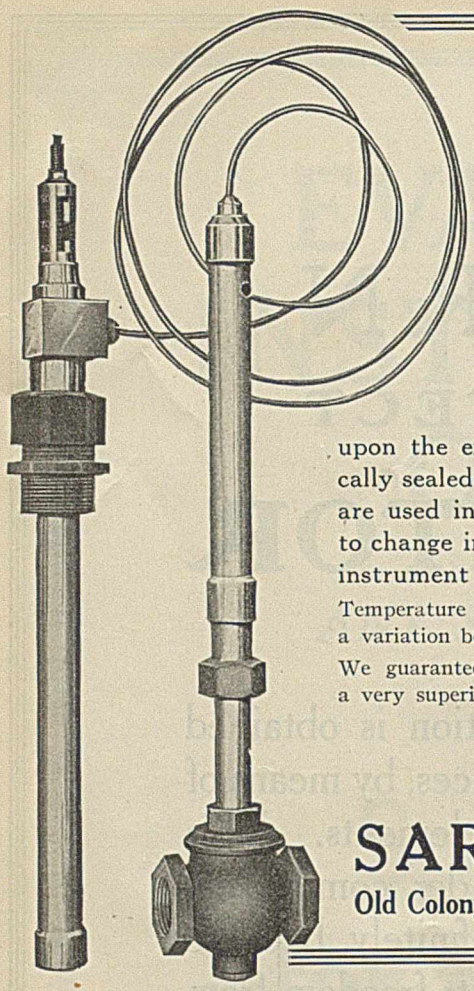

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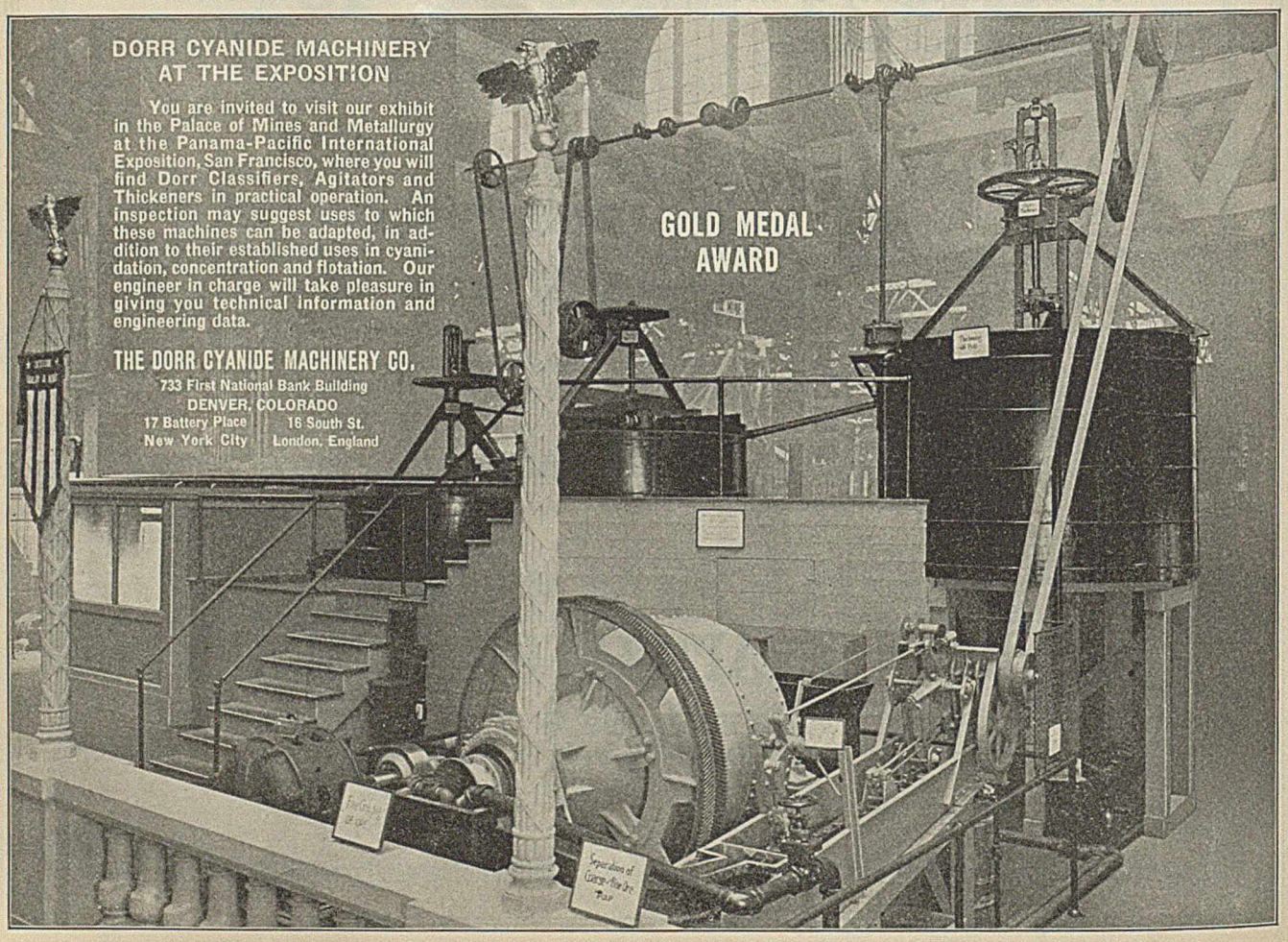

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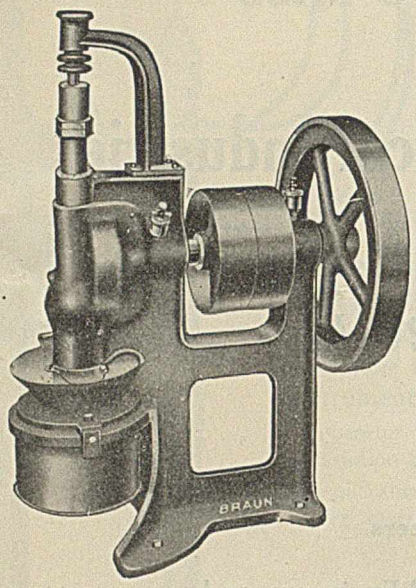

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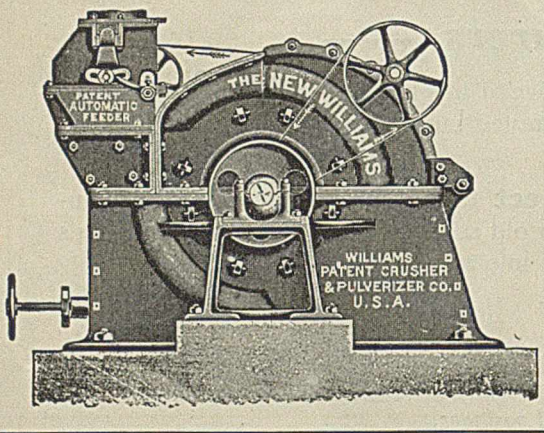

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Published monthly. Subscription price to non-members of the American Chemical Society, $6.00 yearly.
Foreign postage, seventy-five cents, Canada, Cuba and Mexico excepted.
Entered as Second-class Matter December 19, 1908, at the Post-Office at Easton, Pa., under the Act of March 3, 1879.

Contributions should be addressed to M. C. Whitaker, Columbia University, New York City
Communications concerning advertisements should be sent to The American Chemical Society, 42 West 39th St., New York City
Subscriptions and claims for lost copies should be referred to Charles L. Parsons, Box 505, Washington, D. C.

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EDITORIALS

SEATTLE AND THE PUGET SOUND

Attendance at the Seattle meeting of the American Chemical Society means vastly more than the technical fellowship of ordinary meetings. It will be an introduction to the great undeveloped empire of the Pacific Northwest, rich in resources and abounding in latent industrial opportunities. It will be a scenic treat nowhere equalled on the continent—the everchanging vistas will form a never-to-be-forgotten series of scenes which the traveller will ever cherish.

Of foremost importance are the potentialities which arise from rapid development of natural resources. Washington is the "Evergreen State," because its hills and mountains are almost completely enveloped with great forests of fir, cedar, hemlock and spruce. It is true that the lumberman has gone into these forests and cut down large portions of them, but ten million acres are locked up in eleven national reserves and six million acres more are under private ownership. Annually four billion feet of lumber are manufactured in the state and the supply will last for a century more. The chemist will not only be charmed by the richness and sweetness of great forests but he will be interested in studying the great needs of this industry. The waste wood of Washington annually exceeds two and a half million cords, much of which is consumed in the waste wood burners of sawmills and in land-clearing operations. The lumbermen and commercial interests of the region have not been indifferent to the problem of utilization. They have invested over a million dollars in their attempts to utilize this waste and—failed. The most enduring symposium which the chemists can achieve will be one which will point the way to success in this one line of endeavor. The lumbermen are looking for a "Moses" to lead them out of the wilderness.

Other natural resources likewise command the interest and assistance of the chemist. From the waters of Puget Sound and the North Pacific more than a hundred thousand tons of fisheries products are taken each year and an equal quantity of fish offal is produced, of which only twenty per cent is utilized for the manufacture of oil and fertilizer. Floating on the same waters are the great kelps or seaweeds with their well-known potash content; from these can be extracted 750,000 tons of potassium chloride, or nearly twice the quantity annually imported by the United States. At Seattle's back door, in Idaho, are the great phosphate rock deposits in which are found over two billion tons in the areas thus far surveyed. Almost within the city limits begin the Washington coal fields which contain nearly twenty billion tons of coal, o' which only four million tons are consumed annually. Of not less importance is the fact that within easy reach of the Puget Sound district lies one-fifth of the possible water power of the United States. Such is the nature of the resources of the Pacific Northwest which are awaiting rational disposal by skilled technical men and to the problems that arise from them the attention of the chemist is directed.

Seattle and the Puget Sound region are worth seeing from the standpoint of that breadth of experience which the technical man is expected to possess. This city of 300,000 population has become metropolitan far beyond its numbers. Located on rugged hills overlooking Elliott Bay, an arm of Puget Sound, it washed a portion of those hills into the sea to make way for extensive sites of commerce and manufacturing. Other portions lent their natural beauty to that of the landscape artist about the homes that crown them or in the network of parks and boulevards which, with commendable foresight, have been constructed by its citizens. Within the shadow of the Olympic mountains, beside the western sea, surrounded by lake and forest, with blossoms and greensward the year round, Seattle invites the reader to come and see her as she is.

Puget Sound has been described as

> "A land-locked sea with harbors deep and wide
> Where all the navies of the world could hide."

Upon its waters the attendants of the Seattle meeting will spend an entire day on a chartered steamer. Those fortunate enough to attend will behold a great inland sea of nearly two thousand square miles with as many lineal miles of sinuous green wooded shore lines encompassing it. Rising gently from the water's edge in many places, little farms of meadows and orchards have replaced the forest débris left by the logger, but frequently too, may be seen patches of timber of virgin growth while further back to the east and west the rugged and snow-clad mountains stand guard. So picturesque are the scenes that it seems almost an intrusion to note that even now sixty-four steamship lines ply in and out of Seattle on these waters, carrying nearly six million tons of shipping per year, valued at over one hundred and fifty million dollars. Here, then, may we expect one of the gateways to be built through which the commerce and trade of the Orient and of Alaska shall pass in ever-increasing volume.

Space does not permit speaking of those romances whereby deserts have been transformed into orchards riotous in their profusion of green leaves, blossoms and fruit, nor of the mineral wealth yet largely locked up in mountain fastnesses. Again and finally it must be urged upon each individual member of the society that if he enjoys great and beautiful scenes of nature, if he is interested in the wise use of diminishing natural resources, if he is eager to inform himself concerning the opening of the last door to the commerce of a new Orient—then he must join the throng that will gather to make the Seattle meeting a great success.

University of Washington
Seattle

H. K. Benson

FOOD FOR THOUGHT

There is much food for thought, both for our industries and for our educational institutions, in the presidential address recently given before the London Chemical Society, by Dr. William Henry Perkin, on the present position of England in the Organic Chemical Industries.[1]

Dr. Perkin has made a most frank and clear analysis of England's present predicament, has uncovered the unmistakable causes which lead to such a condition of industrial stagnation and has pointed with incisive clearness to the remedial measures which will have to be applied before recovery or substantial growth will ever be possible.

The situation as applied to the organic chemical industries in England is no worse as a result of this war than it is in America and Dr. Perkin's analysis applies with equal force to our undeveloped organic industrial problems, with the important difference that for England the analysis is after the fact—a post mortem—while for us his reasoning and suggestions come in time for guidance. Three points of particular force as applied to American conditions may be selected from Dr. Perkin's address:

(1) "In almost every direction, and to a far greater extent than has been the case in any other country, Germany has recognized the value of the closest possible contact between the industries and the universities. In Germany the majority of the professors and Privatdocenten are in close touch with the large factories, and spend part of their time in solving technical problems which they either devise themselves or which may be submitted to them by the manufacturer. I have it on the authority of several of the best known directors of German works that the atmosphere of the University laboratory is much more suitable for discovery than that of the works, and that, as a fact, many of the most valuable discoveries which subsequently proved to be of the highest technical importance have been made in university laboratories and transfe red to the works. Close association of the universities with the industries does not exist to any extent in this country, and is one of the things we have to aim at in the future. It must be of great advantage to industry and cannot fail to be of great value also to the university, for it must result in the manufacturer taking a keen interest in the welfare of the department with which he is associated. Contact with the research department of a large works must always be stimulating; problems are encountered, many of them of great scientific interest, which would never suggest themselves in strictly academic circumstances, and as one of the results, the tendency, which is always present under existing university conditions, for the professor to become an academic fossil and unproductive, is postponed. Again, contact with the research departments of a flourishing works cannot fail to suggest subjects for investigation which are eminently suitable to occupy the attention of research students, many of whom will ultimately take up technical work. I look forward to the time when the scientific staffs of our universities and technical schools will not only be available for industrial research, but will be encouraged by those in authority to undertake such work."

(2) "It is scarcely necessary to point out that, if a chemical works is to be successful, the first essential is that it must be under chemical control, and that every department must be in the hands of an expert; the board of directors may then be a mixed board, provided that steps are taken to ensure that chemical opinion is largely represented on it. The recognition of the soundness of this principle is one of the main reasons for the success of the German works."

(3) "Failure to develop on research lines is scarcely conceivable if the works is in charge of a highly trained chemical staff, but, on the other hand, if it gets into the power of the business man who wants an immediate return for his outlay, is not willing to wait for results, and fails to appreciate the importance of scientific control, then no tariff can avert disaster."

[1] Published in full in the *Journal of the Chemical Society*, **107** (1915), 557–578. Extended abstract *Jour. Soc. Chem. Ind.*, **34**, 474.

THE SECOND PAN-AMERICAN SCIENTIFIC CONGRESS

Many matters of international character with particular significance to the college world have happened during the scholastic year now closing. The present European war has precipitated a general interest throughout the nation in foreign trade; an interest, however, that has slowly been developing for years through the vision and courage of an organization like the Pan-American Union, conferences and societies with peace and international comity propaganda, large business concerns with foreign trade connections, and various individuals who, by virtue of their position in the service of the Government of the United States or in the international and business world, have not only seen the tendency in the United States to view all things from an enlarged or international viewpoint but have materially assisted in directing, through the press and in public utterance, an ever-growing current of sentiment for a larger commerce and comity of the United States in relation with the other countries of the world. Among these none stand potentially in closer relation with us than the countries of Latin America. Linked to us by propinquity, a common origin and political destiny, Pan-Americanism is not a visionary dream, but is purposed with immediate and practicable results fraught with untold advantages to the entire world through the increase in culture and commerce among the participating countries of this new world group of nations.

During the present year two great Pan-American gatherings convene in Washington under the auspices of the Government of the United States. The first of these, the Pan-American Financial Conference, occurred the week of May the 24, 1915. In this conference delegates from the Latin American countries conferred with representative bankers and business men from our nation at the Pan-American Union, on invitation of the Secretary of the Treasury, on financial questions of pertinent interest that must have far-reaching beneficial results to Pan-American banking and commerce.

Of greater interest to the educational world, however, is the Scientific Congress that will convene in Washington beginning December 27, 1915, and concluding its sessions on January 8, 1916. Through the splendid coöperation of the Latin American countries the second Pan-American Scientific Congress, likewise held under the auspices of the United States Government through the Department of State, bids fair to be not only thus far the greatest Pan-American Congress, but the most important international scientific congress ever held in the United States. The first congress of this name was held in Santiago, Chile, in 1908. It had its origin in earlier Latin American Scientific Congresses; and

at the time of the Santiago congress was enlarged through the generous initiative of the Latin American countries to include the United States. This Congress was well attended by visiting delegates from the United States. On its adjournment, entirely unsolicited on the part of the latter, Washington was designated as the place of meeting of the Second Congress.

This honor has a singular appeal to our nation at this time. The present European war has brought the Western Hemisphere suddenly face to face with grave economic problems that invite the serious attention of scientists and experts in the various fields of applied science. The Scientific Congress will concern itself with the constructive discussion of these as well as with the contributions in the domain of pure science wherein great advance has been made since the last Congress in Santiago, Chile. Science is comprehensively defined by the Congress and includes, under nine heads, such main subjects as: Anthropology; Astronomy, Meteorology, and Seismology; Conservation of Natural Resources, Agriculture, Irrigation, and Forestry; Education; Engineering; International Law, Public Law, and Jurisprudence; Mining and Metallurgy, Economic Geology, and Applied Chemistry; Public Health and Medical Science; Transportation, Commerce, Finance and Taxation.

The significance of the Congress, through the importance of the above subjects, is greatly enhanced through the international reputation of the persons chosen to arrange for the program of the different sections of the Congress, most of whom have an intimate first-hand acquaintance as well with the local resources, development and scientific interest in the various Latin American countries.

Washington offers unusual advantages for a Congress of this nature. It enjoys an enviable distinction among the world capitals for the keen scientific interest and investigation in its various Federal Bureaus, the varied and extensive nature of its libraries and museums, the beauty of its buildings and the growing importance of detached but semi-official institutions and bureaus engaged in work of international scope. Among these none occupy a position of greater importance than the Pan-American Union, the Governing Board of which, composed of the diplomatic representatives of the participating Latin American countries with the Secretary of State of the United States as *Ex-Officio* Chairman, has signally honored the Second Pan-American Scientific Congress by authorizing the use of its beautiful building for the office and sessions of the Congress. The Board also, in response to the request of the President and Secretary of State of the United States, authorized to act as Secretary-General of the Scientific Congress, the Director-General of the Pan-American Union, the Honorable John Barrett, who has doubtless done more than any one American in the establishment of commerce and comity among the republics of the Western world; whose good fortune it has also been to see, through the seeming accident of war, the potential promise of his great work becoming realized so soon.

GLEN LEVIN SWIGGETT

ORIGINAL PAPERS

TOXICITY OF VARIOUS WOOD PRESERVATIVES. II

By RUTH M. FLEMING AND C. J. HUMPHREY

Received June 21, 1915

Since February, 1914, when an article of similar nature was published by us in THIS JOURNAL, **6**, 128, the senior author has run approximately 2300 Petri dish tests upon 46 wood preservatives.[1] This paper will supplement that article by giving further results on several new preservatives and by limiting the toxic points of some of the earlier substances more closely, also by adding a few studies on accommodation to toxic media and vitality of cultures as affected by the age of the fungus transfers. For a fuller discussion of the literature upon the various phases of toxicity and for a more complete description of the effect of each preservative upon *Fomes annosus* and *Fomes pinicola*, the authors would refer those interested to United States Department of Agriculture, *Bull.* **227**, entitled "The Toxicity to Fungi of Various Oils and Salts, Particularly Those Used in Wood Preservation." Results of tests on other properties of these preservatives are reported in Department of Agriculture, *Bull.* **145**, "Tests of Wood Preservatives."

The substances reported upon in the present paper were submitted by various coöperators, the toxicity tests being carried out at the Forest Products Laboratory, Madison, Wisconsin. The tests were confined to the toxic effect of the substances when tested out in nutrient agar by the Petri dish method.

[1] Seventeen of these preservatives are coal-tar creosote and water-gas-tar distillates. Results from these will be published elsewhere in connection with another study.

METHOD

The method of testing is essentially the same as was quite fully explained in the earlier paper,[1] therefore only a summary of the process is necessary here.

The culture medium was prepared according to the following formula:

Extract of 1 lb. lean beef in 1000 cc. distilled water.
25 grams Löfflund's malt extract.
20 grams agar-agar.
(Mixture carefully filtered but reaction not adjusted; slightly acid.)

In making the cultures, 17 cc. of the above medium were measured into 50 cc. glass-stoppered bottles. The oil preservatives were weighed and the salt solutions measured into similar bottles, after which the stoppers were sealed into the preservative bottles with a rubber-glycerine mixture and all were capped with muslin. If necessary, sufficient distilled water was added to the preservative to make 3 cc., the combined medium and preservative always equaling 20 cc. All the bottles were then placed in clamp frames (Page 654, Fig. 1) and sterilized with steam at

[1] THIS JOURNAL, **6** (1914), 128.

100° C. for 35, 30 and 30 minutes, respectively, on three successive days.

After sterilization, both agar and preservative bottles were heated in a water bath and the contents of the former were poured into the latter, thoroughly shaken and the mixture poured into sterile Petri dishes 100 mm. in diameter. Upon cooling, each plate was inoculated at the center (Page 654, Figs. 2 and 3) with a transfer of mycelium 6 mm. square from cultures of *Fomes annosus* Fr. 2 to 3 weeks old. For each set of tests a check culture (Page 654, No. 109) of 17 cc. agar and 3 cc. water was prepared at the same time. These cultures were then placed in an incubator and held at approximately 25° C. for 6 weeks.

This method has proven quite satisfactory in testing the toxicity of most of the oils, but in case of the salt solutions, it is quite probable that some of the constituents of the culture medium combine with the preservative, thus modifying its toxicity. Many studies by various investigators have been made upon this subject which strongly indicate this possibility. For instance, Hawkins[1] found that the germination of spores of the fungus *Gloeosporium cingulatum* was influenced by changing the constituents of the medium although the amount of the toxic agent need not be altered. The toxicity of certain heavy metals, as copper, lead, and zinc was thus diminished by the addition of calcium, magnesium, and potassium nitrates to the culture solutions.

Likewise, Kunkel[2] found, from his numerous experiments upon the influence of starch, peptone, and sugars on the toxicity of various nitrates to *Monilia sitophila*, that the concentration at which various inorganic salts are toxic to this fungus depended on the kind of organic substances contained in the media to which those salts were added. For instance, his tests showed that barium nitrate was more toxic in peptone media than in starch media, while aluminum nitrate and ferric nitrate were more toxic in starch media than in peptone media.

Toxicity varies not only with the medium into which the preservative is introduced but also with the organism. In general, yeasts and molds are less sensitive to toxic substances than the wood-destroying fungi. There is also a difference between the various wood-destroying species, as shown by our former study.

In these tests *Fomes annosus* was selected because of its very destructive effect upon coniferous wood, particularly in mines, because of its wide distribution in the United States, and since it grew well on the agar culture medium used

VARIATION IN GROWTH DUE TO AGE OF TRANSFER[3]

It was noted in the description of our method that only cu tures between 2 and 3 weeks old were used for transfers. The importance of this precaution will be made evident by a study of Tables I and II, where the age of the fungus used for inoculations varies from 6 to 55 days.

The preservatives recorded in Table I apparently always greatly inhibited growth, allowing only a narrow marginal development to appear, even when lower concentrations were used. Since the older and the younger transfers were placed upon the same plate containing a certain concentration, thus being kept under the same conditions, and also since the tests were duplicated with quite similar results, it is almost certain that variation of growth is due principally to the age of the transfers. It is to be noted that in every case the younger culture had the advantage.

TABLE I—VARIATION IN GROWTH IN TOXIC CULTURES DUE TO AGE OF TRANSFER

(Most of these tests were duplicated with quite similar results)

Preservative Sold as	Per cent in medium	Marginal growth of *Fomes annosus* Fr. after 2 weeks		4 weeks		6 weeks	
		Age of transfer (days)					
		15	28	15	28	15	28
Coal-tar creosote, Fraction III, No. 1107	0.125	*	None	8 mm.	*	14 mm.	3 mm.
	0.2	None	None	*	None	2 mm.	None
Coal-tar creosote, Fraction IV, No. 1108	2.2	None	None	None	None	*(a)	None
Age of transfer (days)		16	37	16	37	16	37
Coal-tar creosote, No. 1800	0.15	None	None	3 mm.	*	7 mm.	1 mm.
	0.175	None	None	*	None	1 mm.	*
Water-gas-tar distillate, No. 2233	3.0	*	None	*	*	2 mm.	*

* Growth on transfer only.

(a) In later tests several cultures showed marginal growth on 3 per cent concentrations.

In Table II the variation in growth from different-aged transfers on non-toxic media is still more evident than in Table I. This table shows that the three fungi tested all exhibited a marked difference (Plate I, Fig. 4) for the first ten days. After 20 days but one species showed the same growth of 40 mm. from the 6- and 48-day cultures, and here probably the size of the plate limited the growth, since the younger transfer growth reached the limit (40 mm.) in 14 days, while the older showed but a 32 mm. margin.

TABLE II—VARIATION IN GROWTH IN NON-TOXIC CULTURES DUE TO AGE OF TRANSFER

(Each culture consisted of 15 cc. of 2 per cent malt-extract agar, sterilized with 12 lbs. steam-pressure for 40 minutes and poured into sterile Petri dishes 100 mm. in diameter, one inoculation being made at the center of each plate. The cultures were then kept in an incubator held at approximately 20° C.)

Fungus	Age of transfer Days	Marginal growth in mm. after 4	7	10	14	20 days
Fomes annosus	6	5	15	20	30	40(a)
Fomes annosus	53	None	5	10	24	35
Fomes pinicola	6	5	15	23	40	40
Fomes pinicola	48	1	8	17	32	40
Lentinus lepideus	6	None	8	20	30	40
Lentinus lepideus	55	None	3	12	24	35

(a) 40 mm. margin reached the limit of the plate, so no further growth was possible.

ACCOMMODATION OF FUNGI TO TOXIC SUBSTANCES

Studies on the accommodation of fungi to toxic substances have yielded some interesting results. Pulst[1] found that the green mold, *Penicillium glaucum*, can gradually gain resistance to a toxic substance. He showed that an individual can gradually increase its resistance, without passing to another generation, if sufficient time be given. In his experiments with copper sulfate, he claimed that spores planted from generation to generation upon constantly increasing concentrations of this salt gradually acquired a resistance, so that the last generation endured a much stronger solution than the first.

[1] Lon A. Hawkins, "The Influence of Calcium, Magnesium, and Potassium Nitrates upon the Toxicity of Certain Heavy Metals towards Fungus Spores," *Physiol. Researches*, **1** (Aug., 1913), 57–92.

[2] Otto Kunkel, "The Influence of Starch, Peptone and Sugars on the Toxicity of Various Nitrates to *Monilia sitophila* (Mont.) Sacc.," *Bull. Torr. Bot. Club*, **40** (1913), 624.

[3] The term "transfer" throughout this paper refers to the small square of fungus mycelium, with its adhering agar, which was used for inoculating the Petri dishes.

[1] Carl Pulst, "Die Widerstandsfähigkeit einiger Schimmelpilze gegen Metalgifte," *Jahrb. wiss. Bot. von Pringsheim*, **37** (1902), 205–263.

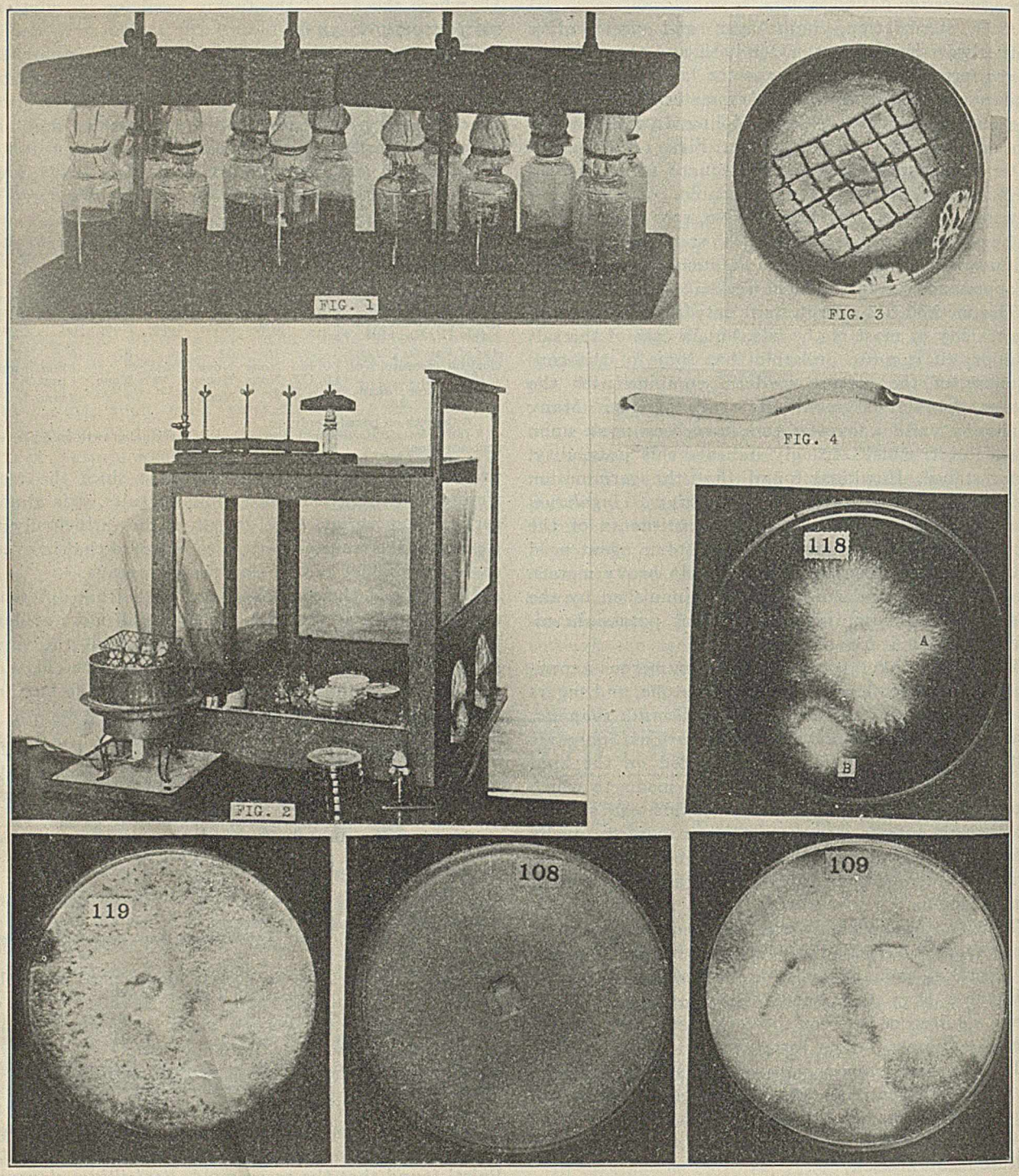


FIG. 1—PRESERVATIVE AND AGAR BOTTLES IN CLAMP FRAME READY FOR STERILIZATION

FIG. 2—INOCULATION CASE WITH HEATING APPARATUS, CLAMP FRAME, AND PILE OF INOCULATED PLATES

FIG. 3—CULTURE OF *Fomes annosus* CUT INTO TRANSFERS

FIG. 4—PLATINUM INOCULATION NEEDLE WITH FLATTENED TIP

No. 118—Non-toxic cultures of *Fomes annosus* showing the retarded growth from transfer 37 days old (B) as compared with 16-day old transfer (A)

No. 119—*Fomes annosus* growing on 40 per cent Timber asphalt, No. 1100. Age of culture, 18 days.

No. 108—*Fomes annosus* growing on 40 per cent kerosene, No. 1847. Age of culture, 6 weeks.

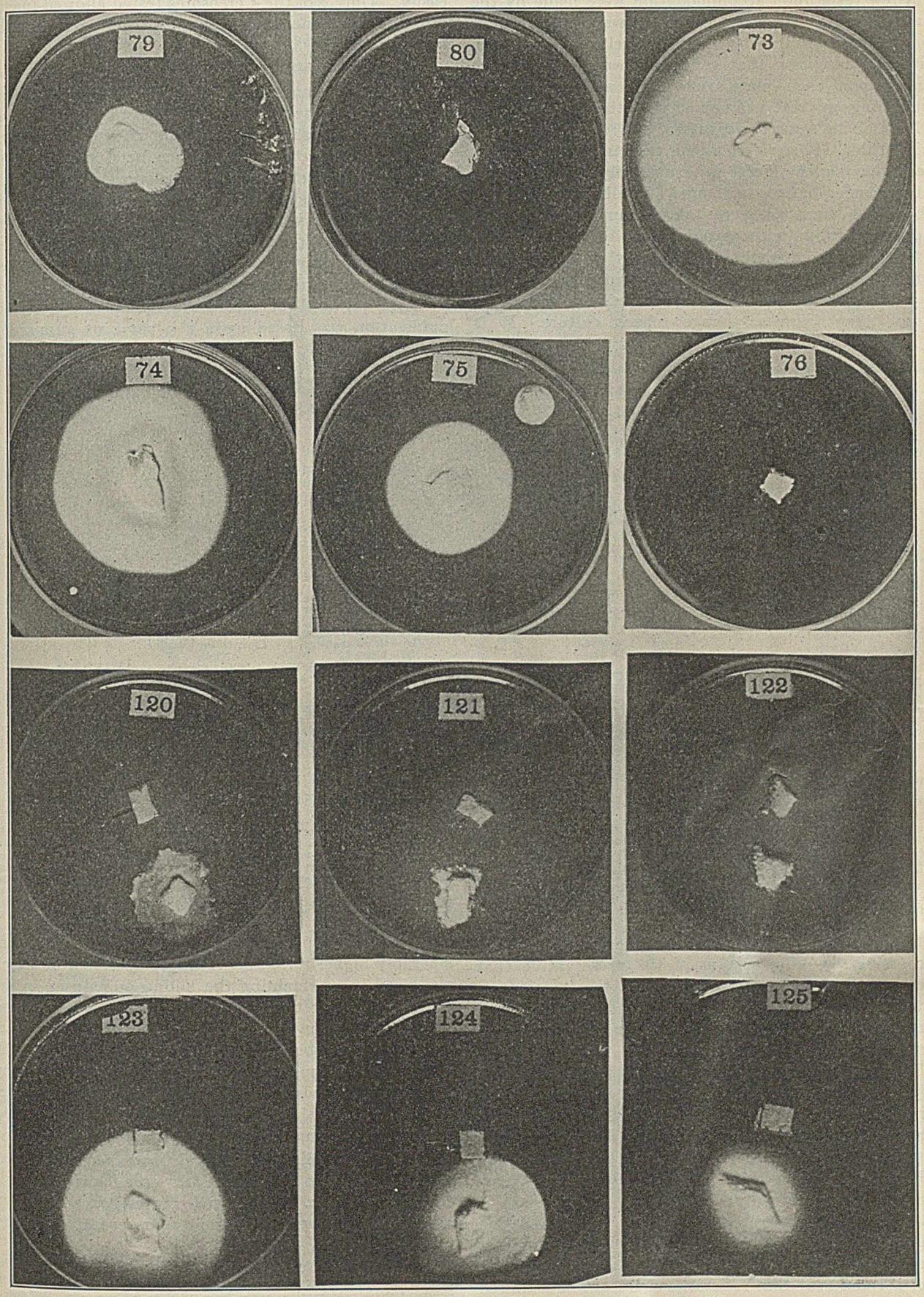
No. 109—Check culture of *Fomes annosus*. Age, 3 weeks.

Nos. 79 and 80—*Fomes annosus* on 0.75 and 1.0 per cent Spirittine, No. 1932. Age of culture, 6 weeks.

Nos. 73, 74, 75 and 76—*Fomes annosus* on 0.05, 0.375, 0.5 and 1.0 per cent C. A. Wood Preserver, No. 1931. Age of culture, 6 weeks.

Nos. 120, 121 and 122—Accommodation cultures of *Fomes annosus*. Transfers from non-toxic cultures show no growth, while transfers from 0.5 per cent Coal-tar Creosote, No. 1756, show growth on 0.4, 0.6 and 0.7 per cent, respectively, of the same preservative.

Nos. 123, 124 and 125—Accommodation cultures of *Fomes annosus*. Transfers from non-toxic cultures show no growth, while transfers from 1.2 per cent Spirittine, No. 1932, show growth on 1.3, 1.4 and 1.5 per cent, respectively, of the same preservative.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A few tests upon accommodation were made by the senior author. The method used was quite similar to the regular toxicity tests described previously, with the exception that generally two transfers were made upon each plate, one from a check culture containing no preservative and the other from a toxic[1] culture of the same preservative.

In Table III are found the results of these tests. Here the reader should note not only the source of each transfer but also the age. In all cases but two, where the transfers were taken from toxic cultures they were fully twice as old as those from the non-toxic cultures. Although the vitality of the transfers from toxic cultures was probably considerably reduced, still they equaled or surpassed the growth of those taken from a younger check culture. It is noticeable that upon the concentrations equal to and surpassing the killing point of the preservative that the growth was always greater from the "accommodated" transfer. The margins of growth from both transfers upon some of the lower concentrations were equal.

The tests on Spirittine (Page 655, Nos. 123, 124 and 125) were the only ones where the experiment was carried further than the first generation. On the 3 per cent Spirittine cultures a good margin of 10 mm. developed. This is a concentration 3 times the killing point for this preservative when inoculated with transfers from non-toxic cultures.

Although these tests showed that accommodation was possible, still it was evident, especially from experiments with the coal-tar creosotes (Page 655, Nos. 120, 121 and 122) that resistance could not be acquired easily. Only 2 of the 5 creosotes tested allowed fungus growth upon concentrations equal to or exceeding the killing point.

[1] By toxic culture is meant a culture containing preservative.

TABLE III—ACCOMMODATION TO TOXIC MEDIUM

Preservative Sold as: *Fomes annosus*	Per cent in medium	Transfers: Age of transfer	Transfers: Source of culture(*a*) (Per cent preservative)	Marginal Growth after 4 weeks	Marginal Growth after 6 weeks	Killing Point(*b*) of preservative (derived from toxicity tests)
Zinc sulfate (by product), No. 1712	0.5	8 wks.	0.4	6 mm.	12 mm.	0.6
		19 da.	0 (check)	6 mm.	12 mm.	
	0.6	8 wks.	0.4	2 mm.	4 mm.	
		19 da.	0	Growth on transfer	Growth on transfer	
	0.8	8 wks.	0.4	None	1 mm.	
		19 da.	0	None	None	
Coal-tar creosote, No. 1720	0.1	7 wks.	0.1	9 mm.	13 mm.	0.125
		19 da.	0	6 mm.	13 mm.	
Coal-tar creosote, No. 1722	0.25	7 wks.	0.25	Growth on transfer	6 mm.	0.3
		19 da.	0	3 mm.	7 mm.	
Coal-tar creosote, No. 1755	0.15	6 wks.	0.2	3 mm.	8 mm.	0.275
		21 da.	0	3 mm.	8 mm.	
	0.2	6 wks.	0.2	3 mm.	20 mm.	
		3 wks.	0	None	2 mm.	
	0.35	6 wks.	0.5	8 mm.	15 mm.	0.55
		17 da.	0	Growth on transfer	4 mm.	
Coal-tar creosote, No. 1756	0.5	6 wks.	0.5	5 mm.	8 mm.	
		17 da.	0	Growth on transfer	Growth on transfer	
	0.6	6 wks.	0.5	Growth on transfer	Growth on transfer	
		17 da.	0	None	None	
Spirittine wood preserver, No. 1932	1.2		1.2_1	Growth on transfer	15 to 20 mm.	1.0
	1.2	37 da.	1.2_2	25 mm.	....	
	1.5	37 da.	1.2_2	20 mm.	....	
	1.5	17 da.	1.2_3	18 mm.	25 mm.	
	1.8	17 da.	1.2_3	18 mm.	25 mm.	
	2.0	4 wks.	1.8_4	15 mm.	15 mm.	
	3.0	4 wks.	1.8_4	10 mm.	10 mm.	
Fomes pinicola						
Coal-tar creosote, No. 1074	0.15	7½ wks.	0.15	20 mm.	....	0.225
	....	....	0	5 mm.	....	
	0.25	7½ wks.	0.15	3 mm.	....	
	....	....	0	Growth on transfer	....	
	0.3	7½ wks.	0.15	1 mm.	....	
	....	....	0	None	....	

(*a*) In this column are given the concentrations from which transfers were made to the other concentrations of the same preservative, indicated in the second column. The sub-figures following the percentages indicate the number of successive transfers from one toxic medium to another. Thus, under Spirittine, "1.2_1" means that in this instance the culture from which the transfer is taken has itself been derived from a toxic culture one "generation" back; the culture indicated as "1.8_4" means that this culture has been successively transferred through four "generations" of varying, usually increasing concentrations. Where no explanations of this sort are made it is to be understood that the transfer was taken from a toxic culture of high efficiency selected from the routine series of ordinary toxicity tests.

(*b*) The killing point is the concentration which will just prevent all marginal growth of the fungus, when the transfer is taken from a culture containing no preservative. This killing point is carried to within an accuracy of approximately 10 per cent, and has been checked at least in duplicate.

RESULTS OF TOXICITY TESTS

In Tables IV and V will be found the results of most of our toxicity tests. In Table IV the preservatives are arranged according to their nature as follows: wood-tar products, coal-tar products, water-soluble salts, and crude and refined petroleum oils.

In Table V the list of preservatives is somewhat extended by adding those of the earlier paper.[1] These are arranged in order of their toxicity and compared to two of the standard preservatives, coal-tar creosote,[2] No. 1074, and zinc chloride, No. 2239. The killing point of the coal-tar creosote as given in our former publication was based upon a 5 per cent gum arabic emulsion of the preservative and was found to be considerably higher than that of the 100 per cent oil which was used in ascertaining the killing point used in the present paper. It is evident by comparing the killing points of the gum arabic emulsion of coal-tar creosote, No. 1074, and wood tars, Nos. 1561 and 1099, with the corresponding pure preservatives that the toxicity was considerably lessened by the addition of gum arabic. Accordingly, the opportunity is taken to make this correction in comparison.

Of the wood distillates, beechwood creosote proved highly toxic, two to three times as effective as coal-tar creosote, No. 1074, which represents an average grade. Of the remaining four representatives of the

[1] THIS JOURNAL, 6 (1914), 128.

[2] Some tests have been made recently on seven coal-tar creosotes distilled in this laboratory from authentic samples of coal tars. The killing points of these preservatives range from 0.125 to 0.3 per cent, all showing a higher toxicity than the coal-tar creosote here reported.

TABLE IV—LIST OF PRESERVATIVES TESTED, SHOWING ESSENTIAL PROPERTIES AND KILLING POINT

No.	PRESERVATIVE SOLD AS:	Killing point (Per cent)	Specific gravity (60° C.)	DESCRIPTION	COÖPERATOR
1	Beechwood creosote, No. 3183	Between 0.12 and 0.24	1.04	Dark brown liquid; liquid at room temperature.	Lake Superior Iron and Chemical Co., Manistique, Mich.
2	Preservol, No. 2236	0.7	1.172	Thick, viscous liquid; probably pyroligneous acid plus wood tar.	Newbold Manufacturing Co., New York, N. Y.
3	Spirittine wood preserver, No. 1932	1.0	1.006	Reddish brown liquid; 0.47% acid; a softwood creosote.	Spirittine Chemical Co., Wilmington, N. C.
4	Wood tar (hardwood), No. 1561(*b*)	....	1.195	Black, viscous liquid with pyroligneous odor; 24% water.	Marden, Orth and Hastings, Chicago, Ill.
	100 per cent preservative	0.625	....		
	20 per cent gum arabic emulsion	1.25	....		
5	Wood tar (Douglas fir), No. 1099(*b*)	....	1.052	Black liquid with strong pyroligneous odor.	Logged-off Land Utilization Co., Seattle, Wash.
	5 per cent gum arabic emulsion	0.65(*a*)	....		
	100 per cent preservative	Between 0.35 and 0.46	....		
6	C. A. wood preserver, No. 1931	1.0	1.12	Brown liquid; probably high boiling fractions of coal-tar creosote.	C. A. Wood Preserver Co., St. Louis, Mo.
7	Coal-tar creosote, No. 1074(*b*)	....	1.048	Liquid; 8.4% water.	Creosote Supply Co., Chalmette, La.
	5 per cent gum arabic emulsion	0.55	....		
	100 per cent preservative	0.35	....		
8	Coal-tar creosote, Fraction III, No. 1107	0.225	1.045	Liquid at room temperature.	Semet-Solvay Co., Ensley, Ala.
9	Coal-tar creosote, Fraction IV, No. 1108	3	1.088	Liquid at room temperature.	Semet-Solvay Co., Ensley, Ala.
10	Coal-tar creosote, Fraction V, No. 1109	33(*a*)	1.15	Heavy tarry liquid.	Semet-Solvay Co., Ensley, Ala.
11	Water-gas tar distillate, No. 2233	6.5(*a*)	1.042	Dark brown liquid.	United Gas Improvement Co., Philadelphia, Pa.
12	Water-gas tar distillate, No. 2235	0.65	0.995	Greenish brown liquid.	United Gas Improvement Co., Philadelphia, Pa.
13	Zinc sulfate (commercial), No. 1711	0.65(*a*)	....	Commercial salt.	
14	Zinc sulfate (by-product), No. 1712	0.6	....	By-product from copper smelter.	Balaklala Cons. Copper Co., Coram, Cal.
15	Bruening and Marmetschke preservative	0.5	....	6⅔% zinc chloride plus 3⅓% aluminum sulfate.	Bruening and Marmetschke, Schoepfurth, Germany.
16	Holzhelfer, No. 2097	11	1.113	Thick greenish brown liquid; partial emulsion of zinc chloride, creosote, and small amount of copper.	Vaughan Paint Co., Cleveland, Ohio.
17	Fuel oil, No. 1103	40+	0.871	Light liquid; odor of crude oil.	U. S. War Department, Picatinny Arsenal, Dover, N. J.
18	Kerosene, No. 1847	40+	0.798	Refined petroleum oil.	
19	Timber asphalt, No. 1100	40+	1.063	Residue from distilling off lighter fractions from a crude oil. Very viscous.	Indian Refining Co., Cincinnati, O.

No.	PER CENT PRESERVATIVE DISTILLING BELOW						
	180	215	245	275	305	320	360° C.
1	....	About 15.7	48.2	72.7	....	....	....
2	13.9% Distills below 205° C.						
3	14.2	23.2	35.2	36.7	....	....	....
4	About 27	About 31	51	....	....	....	....
5	About 16	About 31	54.7	....	....	....	....
6	0.5	2	4	8.2	20.6	28.9	70.1
7	4.8	17.8	44.4	54.1	67.2	74.1	....
8	....	0.9	16.2	49.2	77.7	85	....
9	....	....	0.9	4.7	38.5	54.3	....
10	....	....	....	....	4.1	10.1	48.7
11	3	6.7	21.2	35.3	48.5	53.5	77.6
12	3.3	12.8	37.7	61.7	75.3	80.3	....
16	7.3	7.8	9.9	12.8	23.8	29.6	58.9
17	....	About 3	About 9	About 20	40.6	About 51	About 75
18	25.1	65.5	89.7	....	....	....	....

(*a*) Killing point was not checked in duplicate.

(*b*) A gum-arabic emulsion was tried first. Later the regular method proved satisfactory with coal-tar creosote as the oil made a good mixture with the agar. In case of the two wood tars, the drop method was tried, in which 1, 2, 3, 4, or 5 drops of pure preservative were added directly to the heated agar, shaken and poured. This made a good mixture and was approximately accurate, as the average weight of a drop of this oil from the same pipette had previously been calculated. The killing point given in the earlier publication was taken from tests upon emulsions.

TABLE V—PRESERVATIVES ARRANGED IN ORDER OF TOXICITY TO FOMES ANNOSUS AND SHOWING RATIO TO COAL-TAR CREOSOTE AND ZINC CHLORIDE

PRESERVATIVE SOLD AS:	KILLING POINT: Per cent	KILLING POINT: Lbs. per cu. ft.	Ratio of killing point to Coal-tar creosote, No. 1074 (Killing point 0.35%)	Ratio of killing point to Zinc chloride, No. 2239 (Killing point 0.5%)
Coal-tar creosote, Fraction II, No. 1106	0.225	0.140	1.55	2.2
Coal-tar creosote, Fraction III, No. 1107	0.225	0.140	1.55	2.2
Beechwood creosote, No. 3183	Between 0.12–0.24	0.075–0.150	3–1.5	4.2–2.1
Sodium fluoride, No. 1929	0.25	0.156	1.4	2.0
Cresol calcium, No. 2098	Between 0.14–0.28	0.087–0.174	2.5–1.25	3.6–1.8
Coal-tar creosote, Fraction I, No. 1094	0.30	0.187	1.17	1.7
Coal-tar creosote, No. 1074:				
100 per cent preservative	0.35	0.218	1.0	1.4
5 per cent gum arabic emulsion	0.55	0.343	0.64	0.909
Wood tar (Douglas fir), No. 1099:				
100 per cent preservative	Between 0.35–0.46	0.218–0.287	1–0.76	1.4–1.09
5 per cent gum arabic emulsion	0.65(*a*)	0.405	0.54	0.77
Bruening and Marmetschke preservative	0.5	0.312	0.7	1.0
Zinc chloride, No. 2239	0.5	0.312	0.7	1.0
Zinc sulfate (by-product), No. 1712	0.6	0.374	0.58	0.83
Wood tar (hardwood), No. 1561:				
100 per cent preservative	0.625	0.39	0.56	0.8
20 per cent gum arabic emulsion	1.25	0.78	0.28	0.4
Water-gas-tar distillate (sp. gr. 0.995), No. 2235	0.65	0.405	0.54	0.77
Preservol, No. 2236	0.7	0.436	0.50	0.70
Zinc sulfate (commercial), No. 1711	0.65(*a*)	0.405	0.54	0.77
C. A. Wood Preserver, No. 1931	1.0	0.624	0.35	0.5
Spirittine wood preserver, No. 1932	1.0	0.624	0.35	0.5
S. P. F. Carbolineum, No. 1844	2.25	1.404	0.155	0.22
Coal-tar creosote, Fraction IV, No. 1108	3.0	1.872	0.117	0.17
Avenarius carbolineum, No. 1843	5.25	3.28	0.66	0.095
Water-gas-tar distillate (sp. gr. 1.042), No. 2233	6.5(*a*)	4.05	0.054	0.077
Holzhelfer, No. 2097	11.0	6.86	0.032	0.045
Coal-tar creosote, Fraction V, No. 1109	33.0(*a*)	20.59	0.0106	0.0151
Copperized oil, No. 1095	40	25	0.0088	0.012
Fuel oil, No. 1103	40+	25+	0.0088—	0.012—
Kerosene, No. 1847	40+	25+	0.0088—	0.012—
Timber asphalt, No. 1100	40+	25+	0.0088—	0.012—
Water-gas-tar distillate (sp. gr. 1.058), No. 1101	40+	25+	0.0088—	0.012—
None such special, No. 2696	45+	28+	0.0077—	0.011—
Sapwood antiseptic, No. 1611	75+	46.8+	0.0047—	0.0066—

(*a*) The killing point has not been checked in duplicate but is approximately correct.

group (Preservol, Spirittine, hardwood tar, wood tar from Douglas fir) three are about half as toxic as coal-tar creosote. The fourth, Spirittine (Page 655, Nos. 79 and 80), proved only one-third as toxic.

Further work on Fractions III, IV, and V of coal-tar creosote indicates that Fraction III is somewhat more toxic than first reported; the other two remain essentially the same as the first work demonstrated. As the results stand to date, Fractions II and III are equally highly toxic and with beechwood creosote are the three most toxic compounds reported upon. If the volatility of Fraction I could be controlled, this fraction perhaps would prove equally as toxic as II and III.

Since the greater part of Fractions II and III distils between 215 and 305° C. we may infer that, with the possible exception of phenolic bodies in Fraction I, the more highly toxic constituents of coal-tar creosote have their boiling points between these limits. Additional tests on the two water-gas-tar distillates previously reported upon indicate that the toxic point lies somewhat higher than there indicated. The distillate of low specific gravity (0.995) is somewhat less toxic than coal-tar creosote, No. 1074, while that of high specific gravity (1.042) falls comparatively low in the toxicity scale.[1]

Zinc sulfate (both by-product and commercial) compares very favorably with zinc chloride and also with coal-tar creosote.

When drawing comparisons between zinc chloride and the Bruening and Marmetschke preservative (zinc chloride + aluminium sulfate) it should be kept in mind that zinc chloride cannot be tested satisfactorily by mixing with ordinary nutrient agar, on account of its tendency to combine with the medium. With the straight zinc chloride, different tests have yielded killing points lying between 0.3 and 0.5 per cent; the Bruening and Marmetschke preservative varied between 0.4 and 0.5 per cent.

Holzhelfer, although composed of such toxic constituents as zinc chloride and creosote, must be in comparatively dilute form, since its toxicity is quite low, about 11 per cent being required to prevent the growth of *Fomes annosus*.

The three petroleum oils (Page 654, No. 108) showed but slight or no toxic qualities, in that generally 40 per cent cultures nearly equalled and sometimes even excelled the growth on the check cultures.

Acknowledgments are due Mr. Howard F. Weiss, Director of the Forest Products Laboratory, Madison, Wisconsin, for certain facilities and material supplied, and to Mr. Ernest Bateman, Chemist in Forest Products, of the same Laboratory, for all data upon the physical and chemical properties of the preservatives tested.

INVESTIGATIONS IN FOREST PATHOLOGY, BUREAU OF PLANT INDUSTRY
IN COÖPERATION WITH THE FOREST PRODUCTS LABORATORY
MADISON, WISCONSIN

[1] Some preliminary tests have recently been made at the Forest Products Laboratory, Madison, Wis., on the toxicity of ten authentic water-gas-tar distillates. The approximate killing point of most of these falls considerably below, or around, that of the most toxic water-gas-tar distillate here reported.

A STUDY OF SOME RECENT METHODS FOR THE DETERMINATION OF TOTAL SULFUR IN RUBBER[1]

By J. B. TUTTLE AND A. ISAACS

Received March 15, 1915

PURPOSE OF INVESTIGATION

One of the most important problems in the chemical analysis of rubber compounds is the determination of total sulfur. Many investigators have worked on this subject, with the result that different laboratories have their own methods, and comparison of results obtained by these various methods is always difficult, and at times impossible.

This Bureau is now using in its routine analysis the method of Waters and Tuttle.[2] In order to learn whether or not the methods for this determination which have been recently published were an improvement, either in accuracy or time required, over the one now in use, and if not, to determine wherein these methods are faulty, this present investigation was undertaken.

GENERAL CONSIDERATION

The determination of the total sulfur in rubber is far from being a simple problem, involving as it does the simultaneous determination of sulfur in a number of different substances. Sulfur may be found in vulcanized rubber compounds in any of the following forms:

1—Free sulfur.

2—Sulfur combined with rubber (*i. e.*, vulcanized rubber).

3—Metallic sulfates, usually lead and barium.

4—Metallic sulfides, usually lead and zinc.

5—Sulfur compounds of fatty acids (from the so-called oil substitutes, or "factis").

6—Sulfur in bituminous substances ("mineral rubbers").

The first and second of these are always present, and the others may or may not be, according to the nature of the compound. Any method which has for its purpose the determination of the total sulfur must be adequate to determine any or all of these in widely varying amounts. In our experience in testing material for use in the Government departments, the total sulfur has varied from 1.5 to 25 per cent; the free sulfur from practically nothing to 10 per cent; and sulfur in metallic sulfates from nothing up to 6 per cent. The rubber content varied from 20 to 90 per cent, and the quality of the rubber varied from the best to the poorest. We have no quantitative data on the other sulfur-bearing components of rubber goods, but we are certain that they are frequently present and carry appreciable quantities of sulfur.

The almost universal use of litharge (in amounts sometimes 15 and even 20 per cent) in rubber mixings may have considerable bearing on the determination of sulfur by some methods even though the litharge does not in itself contain sulfur. Its effect on the determination of total sulfur will be referred to later in the discussion of the results obtained by the methods investigated.

[1] Published by permission of the Director of the Bureau of Standards.
[2] Bureau of Standards, *Reprint* **174**; THIS JOURNAL, **3** (1911), 734.

REVIEW OF RECENT METHODS

In connection with the previous publication on this subject from this Bureau,[1] a number of the methods in use at that time were investigated and discussed. Since then several new methods have been proposed. Alexander's[2] method involving the oxidation of the rubber with sodium peroxide was recommended by Allen[3] as a "reliable rapid method." Spence and Young[4] worked on a variation of the electrolytic oxidation first suggested by Gasparini[5] and afterwards developed by Hinrichsen.[6] Kaye and Sharp[7] proposed fusing the rubber directly with a mixture of zinc oxide and potassium nitrate. Ernst Deussen[8] offered a new idea in an attempt to determine only the free sulfur and the sulfur combined with the rubber. After decomposition with concentrated nitric acid and evaporation, he treated the residue with sodium carbonate and water, and filtered, determining the sulfur in the filtrate colorimetrically. The Joint Rubber Insulation Committee[9] proposed a procedure for the complete analysis of rubber insulation material according to which the total sulfur is determined by fusion with a mixture of sodium peroxide and potassium carbonate. While this method was recommended for 30 per cent Para insulation compounds only, it is desirable to know whether it has a wider application. H. P. Stevens[10] suggested a method for correcting for the loss of volatile sulfur in the Henriques method, by absorbing the gases from the determination in alkali and subsequently determining the sulfur thus absorbed. Utz[11] gave a review of the subject in which the method of Kaye and Sharp was compared with that of Frank and Marckwald.[12] He considered the two methods of equal value.

There are two general methods for determining sulfur in organic compounds which have been used to determine the sulfur in rubber, *viz.*, the Carius and the bomb methods. These are so well known that description at this time is unnecessary. Both of them are considered adequate to determine the total sulfur when modified to suit the conditions peculiar to rubber. Such modifications, however, are time-consuming and render these methods undesirable for the routine analysis of rubber goods. It was therefore not considered necessary to give analytical data in this paper.

SAMPLES

Even when the assumed total sulfur content is given, this information is not sufficient to enable one to judge the efficiency of the method, since some methods will give low results with materials containing much free sulfur. For the proper interpretation of the results by any method, the entire composition of the samples used, at least as far as the sulfur-bearing constituents are concerned, should be known and reported.

The samples used in this investigation are described in Table I. Sample A was one of the samples used

TABLE I—COMPOSITION OF SAMPLES

The figures given are approximate percentages only

Sample	Description	Rubber content	Sulfur Total	Sulfur Free	Mineral fillers
A	Insulation	30 Fine Para	5.0	0.5	18 Barytes
B	Suction hose	40 High grade	6.0	0.5	18 Barytes
C	Special	48 Fine Para	4.25(*a*)	0.6	16 Barytes 16 Litharge
D	Insulation	28.5 Fine Para	1.75	1.0	4 Litharge
E	Rubber bands	93 High grade	5.0	2.7	2 Litharge
F	Special	42 Coarse Para	8.1(*a*)	4	30 Sublimed lead 5 Litharge
G	Gasket	55 Poor quality	12.0	8	2 Barytes 2 Litharge
H	White tubing	20 Poor quality	21.0	9	36 Barytes

(*a*) The amount of sulfur added as such in Samples C and F was 2 per cent and 5.4 per cent, respectively.

in the investigations of the Joint Rubber Insulation Committee. Samples B, E, G and H were taken from deliveries on various Government contracts.[1] Sample D was prepared especially for the investigations of the Analytical Committee of the Rubber Section of the American Chemical Society. Samples C and F were specially prepared by one of the authors (J. B. Tuttle) at the factory of the Voorhees Rubber Mfg. Co., at Jersey City, N. J., for the purpose of investigating the determination of total sulfur. Great care was taken in the weighing and mixing. The composition was chosen so as to show the effect upon the analysis of the two commonly used sulfates, barytes and sublimed lead, and the vulcanization was controlled so that one of the samples should have a rather large free sulfur content. These two samples have practically the same composition as many that are frequently met with in our routine work and may therefore be considered as representative of such materials.

METHODS COMPARED

DIRECT SOLUTION METHODS—1. Spence and Young: conc. HNO_3, fuming HNO_3 and electrolysis.

2. Deussen: conc. HNO_3 and extraction with Na_2CO_3.

DIRECT FUSION METHODS—3. Alexander: Na_2O_2.

4. Joint Rubber Insulation Committee: Na_2O_2 and K_2CO_3.

5. Kaye and Sharp: ZnO and KNO_3.

SOLUTION AND FUSION METHODS—6. Frank and Marckwald: fuming HNO_3, fusion with Na_2CO_3 and KNO_3.

7. Waters and Tuttle: conc. HNO_3 and Br, fusion with Na_2CO_3 and KNO_3.

SPECIAL METHOD—8. Acetone extraction, and separate determination of free and residual sulfur.

The methods as originally described by the various investigators were followed as closely as possible. Whenever it was considered advisable to depart from the original method, the reasons therefor are given. Unless otherwise stated, 0.500 gram was taken for each determination. The "fusion mixture" used

[1] Waters and Tuttle, *Loc. cit.*

[2] *Gummi Ztg.*, **18** (1904), 729–730.

[3] Allen's "Commercial Organic Analysis," 4th Ed., Vol. IV, p. 140, 1911.

[4] THIS JOURNAL, **4** (1912), 413.

[5] *Gazz. chim. ital.*, [II] **37** (1907), 426–461.

[6] *Chem. Ztg.*, **33** (1909), 735.

[7] *India Rubber Journal*, **44** (1913), 1189.

[8] *Z. angew. Chem.*, **24** (1913), 494.

[9] THIS JOURNAL, **5** (1914), 78.

[10] *Analyst*, **39** (1914), 74; *India Rubber Journal*, **47** (1914), 785.

[11] *Gummi Ztg.*, **28** (1914), 631–632.

[12] *Ibid.*, **17** (1903), 71.

[1] In this connection it will be of interest to note that G was taken from a delivery offered on a contract calling for 50 per cent fine Para rubber and not over 3 per cent sulfur other than that present as barytes.

was composed of equal parts of sodium carbonate and potassium nitrate. Fusions were made with the gasoline gas generator described by Waters.[1] The barium sulfate precipitates were allowed to stand over night before filtering, and were ignited and weighed in porcelain crucibles. Insoluble residues were examined for sulfur, the amounts of which, if present in appreciable quantities, are given. The reagents used were tested and found to be practically free from sulfur, so that no corrections are necessary on their account. Methods 4, 6, 7 and 8 are intended to determine the total sulfur, while 1, 2, 3, and 5 are intended for the determination of sulfur other than that present as insoluble sulfates.

1—SPENCE AND YOUNG—The rubber was treated with 5 cc. of concentrated nitric acid, and heated gently. When the first reaction was over, about 50 cc. (exact amount was not specified by the authors) of fuming nitric acid were added and the solution electrolyzed. As a source of current, an 8-volt storage battery was used. This was connected directly to the platinum electrodes. The resistance of the electrolytic cell was such that the current was usually between 2 and 3 amperes, though at times it was as low as 1 ampere. After two or three hours, the current was discontinued, the electrodes removed, 1 gram of potassium nitrate[2] was added and the solution evaporated to dryness. The nitric acid was completely removed with hydrochloric acid by several evaporations. A few drops of hydrochloric acid were added, the residue was treated with hot water and filtered. The sulfur in the filtrate was precipitated as usual. The insoluble matter filtered off above was fused with 5 gms. of fusion mixture, extracted with hot water, filtered, and after acidification the sulfur in the filtrate was precipitated as usual.

2—DEUSSEN—The Deussen method was not followed exactly as given by the author. The rubber was treated in a porcelain crucible with concentrated nitric acid and covered. After heating for a short time, the cover was removed and the solution evaporated to dryness. The residue was treated with sodium carbonate and water, and after heating, the solution was filtered. Up to this point the original method was followed exactly. Deussen reduces the sodium sulfate to sulfide and determines the latter colorimetrically. In order to avoid any error introduced by this procedure and to obtain a better comparison with the other methods, we added potassium nitrate to the filtrate, evaporated to dryness and fused. The sulfur in the cooled melt was determined as under the Waters and Tuttle method. The insoluble residue from the sodium carbonate filtration was fused with 5 grams of fusion mixture and the sulfur determined as usual.

3—ALEXANDER—The Alexander method, as given in Allen's "Commercial Organic Analysis," is said to be rapid and reliable. The rubber is intimately mixed with 16 grams of sodium peroxide in an iron crucible provided with a lid through which a small hole has been bored. The combustion is started by introducing through this hole a red hot iron wire. No further heating is required. When the mass is cool it is dissolved in water, the crucible, lid and wire are removed, the solution is acidified with hydrochloric acid and boiled, then filtered if necessary and the sulfate precipitated by means of barium chloride.

4—JOINT RUBBER INSULATION COMMITTEE—The rubber was fused with 4 grams of sodium peroxide and 6 grams of potassium carbonate. The cooled melt was extracted with hot water to which some bromine water had been added. The solution was filtered, acidified with hydrochloric acid and evaporated to dryness to dehydrate silica. About 400 cc. of water were added, the solution made slightly acid with hydrochloric acid, filtered, and the sulfur in the filtrate determined as usual.

5—KAYE AND SHARP—The rubber was mixed with 4 grams of zinc oxide and 2 grams of potassium nitrate, placed in a crucible (both iron and porcelain were used), and covered with a layer of zinc oxide about 1 cm. deep. This was carefully heated, at first with a low, and afterwards with a full Bunsen flame. The crucible and contents were placed in a beaker, covered with water and heated; the solution was acidified with hydrochloric acid and filtered. The sulfur in the filtrate was determined as usual.

The insoluble residue filtered off from the hydrochloric solution was fused with 5 grams of fusion mixture and the sulfur determined as under the insoluble matter in the Spence and Young method.

6—FRANK AND MARCKWALD—The rubber was treated with about 20 to 25 cc. of fuming nitric acid in a porcelain crucible, the vessel covered with a watch glass and allowed to stand over night. The solution was evaporated to dryness, the residue fused with 5 grams of fusion mixture, extracted with hot water and filtered. The filtrate was acidified with hydrochloric acid and the sulfur precipitated as usual.

7—WATERS AND TUTTLE—The rubber was treated in a porcelain crucible with 25 cc. of concentrated nitric acid saturated with bromine, the vessel covered with a watch glass and allowed to stand one hour. It was heated on a steam bath for one hour and then the cover was removed and the solution evaporated to dryness. The residue was fused with 5 grams of fusion mixture, extracted with hot water, filtered, the filtrate acidified with hydrochloric acid and the sulfur precipitated as usual.

8—EXTRACTION WITH ACETONE—Some determinations were made by extracting 2 grams of rubber with freshly distilled acetone for eight hours. The acetone solution was evaporated to dryness, distilled water and bromine added, the solution heated until colorless, filtered, and the sulfur in the filtrate determined as usual. The insoluble residue was examined for sulfur by fusing with 5 grams of fusion mixture. The amount of sulfur thus found was scarcely ever more than a few tenths of a milligram.

The extracted rubber was dried at about 60° C.

[1] THIS JOURNAL, 5 (1913), 853.

[2] Spence and Young add 1 gm. of sodium carbonate, but, inasmuch as this on solution is changed to sodium nitrate, we used potassium nitrate, which serves the same purpose and obviates the spattering caused by the addition of a carbonate to the hot concentrated acid.

and the sulfur determined according to the method of Waters and Tuttle. The sum of these various determinations should be the total sulfur.

DISCUSSION OF RESULTS

Although the method of Waters and Tuttle is No. 7, it has been considered advisable to discuss it first since it is the most reliable and accurate method we have found for the determination of total sulfur. The reaction proceeds slowly without any very great evolution of heat so that there is little or no chance of losing free sulfur. Even when the free sulfur is very high the method is adequate to determine it with accuracy. A large number of determinations were made, and the results are concordant and agree with the calculated results in samples of known composition.

The Waters and Tuttle method has been in use at the Bureau of Standards for a number of years, and during that time has frequently been used in determining the total sulfur in samples of known composition. The results have invariably been satisfactory even when obtained by comparatively inexperienced analysts.

The methods which have been compared in the course of this investigation may be divided into two classes, *viz.*, those for the determination of the total sulfur, and those for the determination of sulfur other than that present in the insoluble sulfates. They may be further classified, according to the method of attack employed, as follows: direct solution, direct fusion, and solution and fusion methods.

The methods which have for their object the determination of sulfur other than that present in the insoluble sulfates (Nos. 1, 2, 3, and 5), attempt to separate the insoluble sulfates by filtration. Spence and Young, Alexander, and Kaye and Sharp filter from an acid solution. The securing of correct results by this method is based upon the obviously incorrect assumption that the lead sulfate originally present would remain insoluble while that formed from the litharge would be completely dissolved. Deussen filters from an alkaline carbonate solution, but this procedure is open to the objection that lead sulfate will react with sodium carbonate solution with the formation of soluble sodium sulfate. It is apparent, therefore, that such methods cannot give reliable results since their basic principles are faulty.

Considering the methods as classified according to the mode of attack, we find that the direct solution methods (Nos. 1 and 2) employ concentrated nitric acid. The use of this reagent in the determination of the total sulfur in rubber was first suggested by Henriques, and many investigators have shown that its use gives low results, probably on account

RESULTS OF TESTS FOR SULFUR

METHOD	1—Spence and Young			2—Deussen			4—Joint Rubber Insulation Committee	5—Kaye and Sharp			6—Frank and Marckwald	7—Waters and Tuttle	8—Extraction with acetone		
Sample	Filtrate	Residue	Total	Filtrate	Residue	Total	Total	Filtrate	Residue	Total	Total	Total	Extracted	Residue	Total
A	....	....	....	....	....	....	4.90	....	....	....	....	4.87	....	....	....
	....	....	....	....	....	....	4.94	....	....	....	....	....	....	....	....
B	....	....	....	4.53	1.66	6.19	6.26	3.63	2.43	6.06	6.00	6.29	0.51	5.74	6.25
	....	....	....	4.84	1.41	6.25	6.31	....	....	....	6.18	6.30	0.40	5.90	6.30
	....	....	....	3.84	2.74	6.58	....	....	....	....	6.26	6.33	0.44	5.85	6.29
	....	....	....	3.89	2.65	6.54	....	....	....	....	6.28	6.35	....	....	....
	....	....	....	....	....	....	....	....	....	....	....	6.42	....	....	....
	....	....	....	....	....	....	....	....	....	....	....	6.42	....	....	....
	....	....	....	....	....	....	....	....	....	....	....	6.43	....	....	....
	....	....	....	....	....	....	....	....	....	....	....	6.44	....	....	....
C	....	....	....	3.19	0.88	4.07	4.09	3.38	0.66	4.04	4.19	4.17	0.61	3.59	4.20
	....	....	....	2.55	1.52	4.07	4.13	2.45	1.68	4.13	4.20	4.18	0.63	3.60	4.23
	....	....	....	....	....	....	4.19	3.32	0.86	4.18	4.28	4.20	0.60	3.64	4.24
	....	....	....	....	....	....	4.31	....	....	....	....	4.22	....	....	....
	....	....	....	....	....	....	....	....	....	....	....	4.23	....	....	....
	....	....	....	....	....	....	....	....	....	....	....	4.25	....	....	....
D	....	....	....	....	....	....	1.73	....	....	....	....	1.65	....	....	....
	....	....	....	....	....	....	1.76	....	....	....	....	1.67	....	....	....
	....	....	....	....	....	....	1.78	....	....	....	....	1.70	....	....	....
	....	....	....	....	....	....	1.80	....	....	....	....	1.73	....	....	....
	....	....	....	....	....	....	1.81	....	....	....	....	1.75	....	....	....
	....	....	....	....	....	....	1.83	....	....	....	....	1.78	....	....	....
E	4.91	....	....	....	....	....	....	....	....	....	....	4.95	....	....	....
	....	....	....	....	....	....	....	....	....	....	....	5.15	....	....	....
	....	....	....	....	....	....	....	....	....	....	....	5.22	....	....	....
F	5.39	2.33	7.71	7.47	0.47	7.94	7.78	6.89	0.21	7.10	7.72	7.90	3.59(a)	4.22	7.81
	6.90	0.88	7.78	7.74	0.22	7.96	7.80	6.81	0.38	7.19	7.78	7.96	3.26(a)	4.81	8.07
	6.42	1.36	7.78	....	....	....	7.83	....	....	....	7.80	7.96	4.02	4.06	8.08
	5.04	2.75	7.79	....	....	....	8.01	....	....	....	7.86	7.96	4.04	4.04	8.08
	4.67	3.17	7.84	....	....	....	8.02	....	....	....	7.88	8.00	....	....	....
	5.05	2.81	7.86	....	....	....	....	....	....	....	....	8.01	....	....	....
	4.52	3.38	7.90	....	....	....	....	....	....	....	....	8.02	....	....	....
	4.71	3.26	7.97	....	....	....	....	....	....	....	....	8.09	....	....	....
	....	....	....	....	....	....	....	....	....	....	....	8.11	....	....	....
	....	....	....	....	....	....	....	....	....	....	....	8.12	....	....	....
	....	....	....	....	....	....	....	....	....	....	....	8.12	....	....	....
	....	....	....	....	....	....	....	....	....	....	....	8.13	....	....	....
G	11.49	0.35	11.84	5.52	4.04	9.56	10.98	9.89	0.04	9.93	11.56	11.96	8.31	3.69	12.00
	11.45	0.40	11.85	5.51	4.71	10.22	11.34	9.77	0.57	10.34	11.64	12.00	8.14	3.88	12.02
	11.46	0.39	11.85	8.33	2.81	11.14	12.04	9.80	0.55	10.35	....	12.04	8.06	3.97	12.03
	11.52	0.34	11.86	7.96	3.43	11.39	12.10	10.74	0.03	10.77	....	12.08	....	....	....
	11.36	0.53	11.89	....	....	....	....	10.42	0.41	10.83	....	12.16	....	....	....
	11.57	0.32	11.89	....	....	....	....	....	....	....	....	12.18	....	....	....
	11.43	0.47	11.90	....	....	....	....	....	....	....	....	12.19	....	....	....
	11.56	0.34	11.90	....	....	....	....	....	....	....	....	12.20	....	....	....
	11.47	0.45	11.92	....	....	....	....	....	....	....	....	12.23	....	....	....
	11.44	0.48	11.92	....	....	....	....	....	....	....	....	12.29	....	....	....
H	....	....	....	15.77	4.94	20.71	20.52	15.68	5.20	20.88	20.71	21.09	9.60	11.52	21.12
	....	....	....	15.69	5.16	20.85	20.68	....	....	....	....	21.16	....	....	....
	....	....	....	....	....	....	20.74	....	....	....	....	21.20	....	....	....
	....	....	....	....	....	....	20.83	....	....	....	....	21.30	....	....	....
	....	....	....	....	....	....	....	....	....	....	....	21.32	....	....	....
	....	....	....	....	....	....	....	....	....	....	....	21.36	....	....	....
	....	....	....	....	....	....	....	....	....	....	....	21.40	....	....	....

(a) These samples were not completely extracted.

of the loss of free sulfur. Even when the sulfur which is remaining in the insoluble residue is included with that in the filtrate, the sum does not equal the calculated value.

The direct fusion methods (Nos, 3, 4, and 5) give results which are satisfactory only when the free sulfur content is relatively low. In view of the results obtained by the other fusion methods, it was not considered necessary to make any determinations by the Alexander method. The reaction between rubber and sodium peroxide often proceeds with explosive violence, particularly so when, as in this method, the sodium peroxide is not diluted with some less active flux. The more important points have been demonstrated by the results on the other methods, namely, (1)—that the direct fusion may give low results, and (2)—that the filtering of the solution of the melt after the addition of acid gives results which have no relation to the sulfur it is desired to determine.

Although the reaction during the fusion in the Kaye and Sharp method is not attended by an explosion, the results show that it is open to all the other objections which have been made above; hence it cannot be relied upon to give results which have any significance.

The results obtained by the method of the Joint Rubber Insulation Committee (No. 4) are accurate when the free sulfur is low, as it is in insulation compounds, so that it may be relied upon to do all that this committee has claimed for it. This has been also substantiated by the work of the Analytical Committee of the Rubber Section of the American Chemical Society.[1] Whenever the free sulfur content is high, our results indicate that this method has the same serious defect as the other direct fusion methods.

The methods which require both solution and fusion yield the most satisfactory results. One of these (the Waters and Tuttle method) has already been referred to. The Frank and Marckwald method is at times very satisfactory, but unfortunately it does not seem reliable with large amounts of free sulfur. The reaction between the rubber and the fuming nitric acid is at times very violent and considerable heat is evolved. In fact in several cases, by adding only 1 or 2 cc. of the acid, the heat was so great as to cause the rubber to take fire. It seems probable that this heating is responsible for the loss of sulfur and the consequent low results.

In view of the fact that the free sulfur can be determined by several methods (one of which has already been described) with considerable accuracy in the acetone extract, and since this determination is usually made in analyses of vulcanized rubber goods, it is possible, and in some cases may be convenient, to determine the total sulfur by adding to the result for free sulfur, the amount found in the residue after acetone extraction. Such a method would have the advantage of first removing the free sulfur, which has been found to be one of the most disturbing factors in many of the methods for the determination of total sulfur. Our experience indicates that accurate results can be obtained by this method.

We have determined the sulfur remaining in the rubber after the acetone extraction, by the Waters and Tuttle method. It is more than possible that other methods will be equally efficient.

OUTLINE OF THE METHOD ADOPTED BY THE BUREAU OF STANDARDS

As the result of this and other investigations and the experience of the Bureau of Standards, extending over some years, we believe that the Waters and Tuttle method is the most reliable and it has been adopted for use in the routine work there. The determination is made as follows:

Half a gram of rubber is placed in a porcelain crucible of about 100 cc. capacity, 20 to 25 cc. of concentrated nitric acid which has been saturated with bromine, are added, the crucible covered and allowed to stand for 1 hour. It is then heated gently for 1 hour, after which the cover is removed, rinsing it with a little distilled water, and the solution is evaporated to dryness.

Five grams of fusion mixture (1 potassium nitrate : 1 sodium carbonate) and 3 or 4 cc. of distilled water are added, the mixture is digested for a few moments on the steam bath and then spread halfway up the side of the crucible to facilitate drying. The drying is done on a steam bath or electric hot plate; in the latter case care is taken to avoid spattering caused by possible overheating. When dry, the mixture is fused over a sulfur-free flame until all the organic matter has been destroyed and the melt is quite soft. The crucible and contents are cooled, placed in a 600 cc. beaker, covered with distilled water and heated on the steam bath for 3 or 4 hrs. The solution is then filtered and the insoluble matter washed thoroughly. The combined filtrate and washings should amount to about 500 cc. About 7 or 8 cc. of concentrated hydrochloric acid are added, the beaker covered, and the solution heated almost to boiling. The solution is now tested and if necessary made slightly acid toward Congo paper; if the directions have been followed exactly, there should be a slight excess of acid present. Ten cc. of 10 per cent barium chloride solution are added, and the solution is allowed to stand over night. The precipitated barium sulfate is filtered off and ignited over a small Bunsen flame, care being taken to see that the filter paper does not inflame. The barium sulfate is calculated to sulfur by means of the factor 0.1374.

SUMMARY

It is shown that the methods which have been proposed for the determination of the total sulfur other than that present as insoluble metallic sulfates, are not satisfactory.

It is shown that loss of sulfur is likely to occur in the direct fusion methods, and this loss is apt to increase with increasing free-sulfur content.

The method of Waters and Tuttle is recommended for the determination of total sulfur. This method is accurate and comparatively rapid, and has given

[1] This Journal, 6 (1914), 514–518.

satisfactory results in the hands of a number of analysts over a rather extended period of time.

A new suggestion is offered, namely, to determine separately the free sulfur and the sulfur remaining after the acetone extraction, reporting the sum of the two quantities as the total sulfur. This procedure eliminates the troublesome effect of the free sulfur upon the determination of the total sulfur.

The authors wish to express their appreciation of the many suggestions made by Dr. C. E. Waters, of this Bureau, and of the assistance given by the Voorhees Rubber Mfg. Co., of Jersey City, in permitting us to make up some compounds of known composition in their factory.

BUREAU OF STANDARDS, WASHINGTON, D. C.

PRELIMINARY EXPERIMENTS ON THE EFFECT OF TEMPERATURE CONTROL ON THE YIELD OF PRODUCTS IN THE DESTRUCTIVE DISTILLATION OF HARDWOOD

By R. C. PALMER[1]

Received April 6, 1915

It is well known that in the destructive distillation of wood the products methyl alcohol and acetic acid are formed by a decomposition of the wood substance and that the reaction is accompanied by an evolution of heat. The heat supplied by the exothermic character of the decomposition when added to the heat furnished from some external source, tends to raise the temperature at which the reaction is taking place. Increasing the temperature of the wood beyond the point where spontaneous decomposition takes place will increase the speed or violence of the reaction, and this condition in turn will accelerate the rate at which the temperature is further increased.

There can be no doubt that subjecting the methyl alcohol and acetic acid to an excessive temperature at the moment of formation may result either in an immediate decomposition of some of these products or may prevent their formation from some intermediate products, and probably increases the tendency for many secondary reactions to take place.

Several facts would seem to fully substantiate this viewpoint. The yield of alcohol and acid in the destructive distillation of wood is much less than the proportion of methoxy and acetyl groupings would lead one to expect. Small scale distillations, where the opportunity for secondary decomposition and interreactions are minimized by better control, frequently yield much more acid or alcohol than the usual commercial distillations.

These fundamental considerations indicate that the speed and temperature of the destructive distillation reaction have an important effect on the formation of alcohol and acid. It would seem then that the amount of these products could be materially increased:

1—By causing the reaction to take place at as low a temperature as possible.

2—By decreasing the speed of the reaction.

These two methods may be in effect the same under certain circumstances, owing to the exothermic nature of the reaction, since low temperature distillation is a result of slowing down the reaction.

The fact that increasing the time of distillation will increase the yield of valuable products is generally known in commercial wood distillation practice. Lengthening the time of the complete process simply means slowing down the entire decomposition. In the study described in this paper, the application of temperature control to the critical stage of the decomposition has shown that a similar result may be obtained without increasing the time.[1]

EXPERIMENTAL

In making a large number of destructive distillations[2] in laboratory apparatus as a part of studies on the relative value of different species of hardwoods, it became apparent that the temperature at which the reaction took place and the critical stage had as much influence on the yield of products as the theoretical considerations would indicate.

A more detailed laboratory study of this interpretation of temperature control was therefore made. The basic principles developed were then applied to a commercial plant in order to determine their practicability. The experiments were carried on at the Forest Products Laboratory,[3] Madison, Wis., and in the plant of the Cleveland Cliffs Chemical Company, Gladstone, Mich., as a part of a series of studies on methods of increasing the yields of valuable products in the destructive distillation of hardwoods.

This opportunity is taken to acknowledge the assistance and many helpful suggestions of Mr. H. C. Merriam, operating superintendent in the wood distillation plant of the Cleveland Cliffs Iron Company, in conducting the commercial experiment and interpreting and applying the results.

PART I—LABORATORY DISTILLATION

APPARATUS—The retort used in the laboratory studies is shown in Fig. 1. This retort (A) held approximately 80 lbs. of wood. The oil jacket (B) completely surrounded the circumference of the retort, the ends being insulated with heavy asbestos packing. The oil was heated by means of a row of 20 Bunsen burners, the flame playing largely on the side of the oil jacket, as in this way it was found that a fairly good natural circulation of the hot oil could be obtained. By means of the Bunsen burners the temperature of the heating medium was controlled fairly easily.

The temperature within the retort was measured in three places: At (1) which is close to the inner shell of the retort, directly above the point where the flames play on the oil jacket; the temperature at this point was also approximately the highest temperature of the oil at all times; at (4) which is a point at the bottom

[1] Chemist in Forest Products, Forest Products Laboratory, Madison, Wisconsin.

[1] Attention was first called to the effect of "slow and fast" distillation on the yield of products by Sennft, but since the comparison was made between distillation from the cold and distillation beginning with red hot retorts, the results could not be interpreted to actual practice.

[2] A detailed description of methods of distilling the wood and analysis of products is given in United States Department of Agriculture, *Bull.* **129**, "Yields from the Destructive Distillation of Certain Hardwoods."

[3] Maintained by the Forest Service, U. S. Department of Agriculture, in coöperation with the University of Wisconsin.

of the retort near the inner shell corresponding to (1); and at (5), the center of the retort.

UNCONTROLLED DISTILLATION—The laboratory retort distillations were made in all cases on pieces of wood approximately 18 in. × $2^1/_2$ in. × 1 in. sawed from 1 in. lumber to insure average material. The raw material consisted of maple, beech, and birch. The largest number of tests were made with maple and the best comparisons obtained with this species. The samples tested in comparative runs did not differ more than 2 or 3 per cent in moisture content, and showed from 12 to 15 per cent of the dry weight as moisture.

For the purposes of studying the effect of control it was necessary to have for comparison distillations conducted rapidly and at a comparatively high temperature. The manner of making the distillations was as follows: The burners were so regulated that the maximum temperature of the oil was not higher than 270° C. until the center of the retort reached at least 175° C., at which point it was considered that the moisture in the charge was largely distilled off. As soon as the center temperature was about 175°, the gas was so regulated that the oil was raised as quickly as possible to about 350° C.[1] and the distillation allowed to proceed to the end. The distillation practically stopped when the center reached its maximum temperature and began to fall. In all cases this maximum in the center was higher than the temperature of the oil (indicated at (1)) showing the exothermic character of the reaction. The exothermic reaction was further indicated by a rise of 30 to 50° C. in the center after the gas was turned off and the temperature at (1) was falling.

A distillation of this kind was comparable in many ways with the commercial method of distilling, especially in relation to the rise in temperature during the critical part of the distillation.

The exothermic destructive distillation of hardwood begins at approximately 275° C. and this point is indicated by the appearance of free tar in the distillate. In the laboratory, where the temperature difference between the heating medium and the wood is negligible and the variation in temperature in different parts of the retort is not great, the critical part of the distillation may be considered either as the period after the average temperature has reached 275° or after tar appears in the distillate.

CONTROLLED DISTILLATION—The control of the distillation, as interpreted in this study, required that the largest possible portion of the reaction be completed at the lowest possible temperature, or, in other words, that the rate of rise of temperature during the critical state of the reaction should be at its minimum. The control distillations were conducted by regulating the burners so that the heating medium was not higher than the critical decomposition temperature (275 to 300° C.) until the temperature in the retort and the rate of flow of distillate indicated that the reaction was being stopped. The center temperature indictaed at (5), (Fig. 1) usually passed 275° C. and reached nearly 300° C. when the temperature in (1) began to fall, indicating the checking of the reaction. The oil bath was then raised as quickly as possible to 350° C. and the distillation allowed to finish.

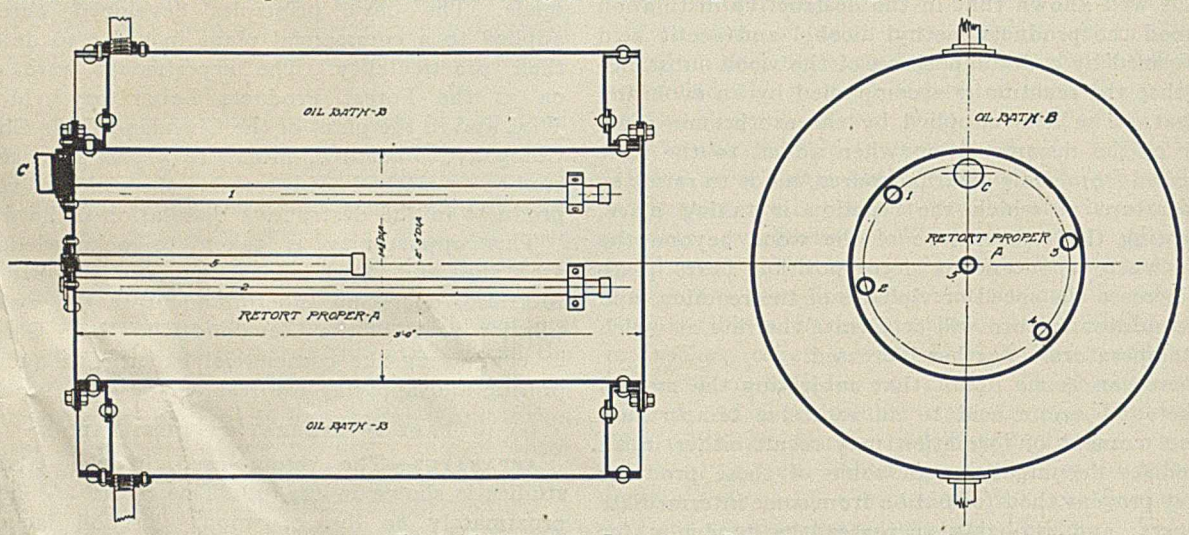

FIG. 1—EXPERIMENTAL LABORATORY RETORT

The crude pyroligneous acid liquor obtained in the distillations was analyzed for its acetic acid and alcohol content by the methods given in "Technologie der Holzverholung," by M. Klar, p. 337.

RESULTS OF LABORATORY TESTS

The results of the laboratory tests are given in Table I. The data are given (1) in terms of percentage of wood alcohol and acetic acid per unit weight of the oven-dry wood distilled and (2) as gallons of 95 per cent alcohol and lbs. of 80 per cent acetate of lime per cord of wood. One cord is taken as 80 cu. ft. of solid wood based on actual determination of a commercial cord which equaled 342.5 lbs. for maple wood containing 15 per cent of its dry weight as moisture.

From these data the effect of controlling the distillation is seen to increase the yield of alcohol 45 per cent for maple, 6 per cent for beech, and 7 per

[1] The oil used was a high flash cylinder oil, f. p. 330° C. The temperature was raised above this point by keeping the oil under 15 to 20 pounds pressure, the pressure being relieved only when the decomposition became excessive as indicated by a rapid rise in pressure.

cent for birch, while the increase in acetic acid was 2, 9, and 5 per cent, respectively.

INTERPRETATION OF RESULTS—The curves designated X in Fig. 2 show the relation between the percentage of total distillate and the average temperature of the retort (average of the temperatures indicated at (1) and (5), Fig. 1). Curve A is the average for the controlled distillations and curve B the average for the uncontrolled distillations obtained with maple wood. The tar point has been indicated on each curve and the portion of the curve above the tar point, principally that nearest to it, is considered the critical stage of the distillation.

TABLE I—RESULTS OF LABORATORY TESTS ON EFFECT OF TEMPERATURE CONTROL ON YIELDS OF DISTILLATION PRODUCTS

Species of Wood Used	Yield of Wood Alcohol				Yield of Acetic Acid			
	Uncontrolled		Controlled		Uncontrolled		Controlled	
	% of wt. of dry wood	Gal. 95% alc. per cord	% of wt. of dry wood	Gal. 95% alc. per cord	% of wt. of dry wood	Lbs. 80% acetate of lime per cord	% of wt. of dry wood	Lbs. 80% acetate of lime per cord
Maple	1.56	7.4	2.16	10.2	5.29	240	6.30	290
	1.59	7.5	2.36	11.15	5.74	267	5.45	251
	1.62	7.6	2.41	11.25	5.91	275	5.52	256
Av.	1.59	7.5(*a*)	2.31	10.90	5.65	261(*b*)	5.76	266
Beech	2.01	9.2	2.15	9.80	5.70	259	6.28	285
	2.03	9.28	..	...	5.78	262	..	...
	2.07	9.45	..	...	5.85	266	..	...
Av.	2.04	9.31	2.15	9.80	5.77	262	6.28	285
Birch	1.59	6.95	1.73	7.6	6.58	284	6.96	301
	1.67	7.32	1.76	7.7	6.50	281	6.78	292
Av.	1.63	7.15	1.75	7.65	6.54	282	6.87	296

(*a*) The average yield from a number of more normal uncontrolled laboratory distillations on maple was 9.00 gallons of alcohol and 253 pounds of acetate.

(*b*) In converting the acetic acid yields to acetate of lime, the results have been decreased 5 per cent in order to allow for the usual commercial sludge loss.

From curves A and B, it would appear that two things might account for the marked increase in alcohol:

1—The actual temperature at which the reaction has taken place in curve A is from 20 to 50° C. lower than curve B.

2—The rate at which the distillation has taken place, indicated by the per cent distillate per degree rise, is slower for A than for B. The first 20 per cent of distillate after the tar point in curve A came off during a rise in temperature of 22° while at a corresponding period in curve B the rise was 33°.

The uncontrolled runs given for maple were pushed as fast as possible in order to give a reaction that would determine the extreme effect of this procedure as compared with especially controlled methods. A number of more normal uncontrolled distillations for this species gave 9.00 gal. of alcohol per cord and 253 lbs. of acetate. The curve is not shown for these runs; it lies very nearly between A and B but with a slope more like curve B.

Similar curves for the distillations on beech and birch have not been shown, but these were found to lie much closer together than the curves for maple and have only slight differences in rate of distillation (upward slope of curve). It may, therefore, be considered that the comparatively small increases in yields for these species are explained by relatively less actual control of the distillation as compared to the runs with maple.

In the case of the maple runs the yields of alcohol obtained in the laboratory tests, particularly those obtained in the more normal uncontrolled distillations, are very nearly the same as yields from commercial plants, but the yields of acetate are about 40 per cent higher than commercial yields. It will be noted that the small average increase in acetate in the controlled runs is due to an exceptional run while the yields from the other two are actually lower than two of the uncontrolled runs. Neither varying the temperature of the reaction within the limits of the laboratory test nor a change in the rate of distillation appears then

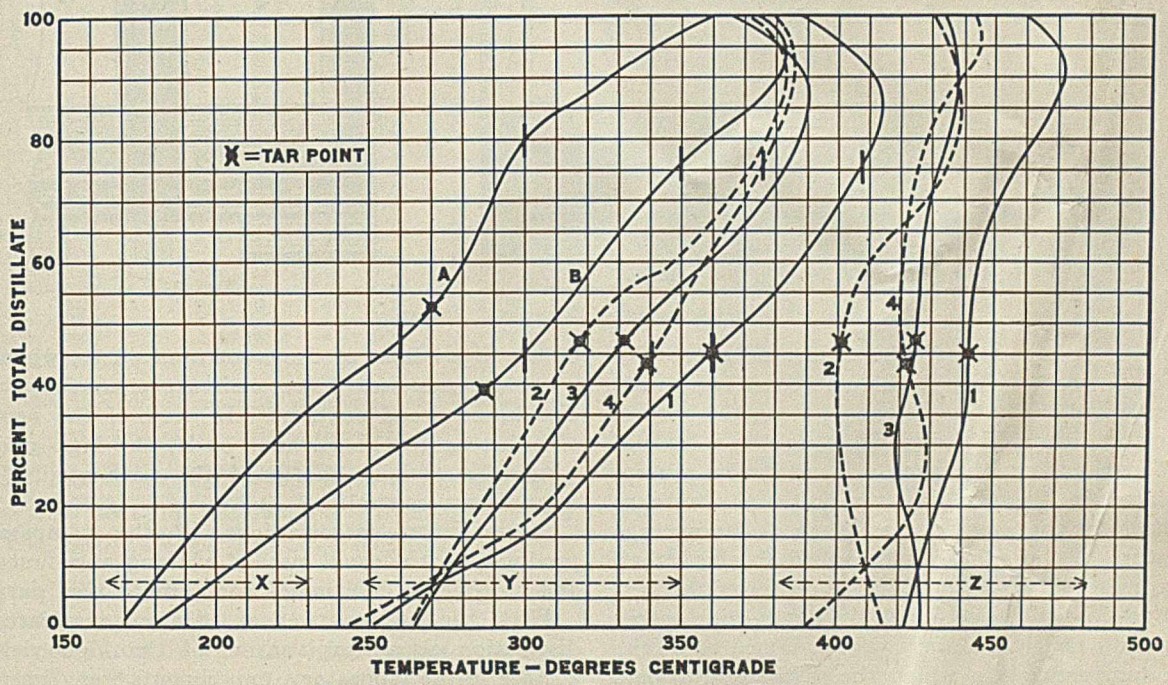

FIG. 2—RELATION BETWEEN TEMPERATURE AND DISTILLATE

X = Laboratory Retort Vapors Y = Commercial Retort Vapors Z = Commercial Retort Flues

to be the cause of the high acetate yield. However, it was known that the temperature at which the distillation reaction is carried out commercially is much higher than in the laboratory and an application of this fact seemed to be a possible method of approaching the laboratory yield.

In order to test the practical value of these results, it was, of course, necessary next to conduct distillations with a commercial retort. The commercial test was made (1) to measure the yields of alcohol and acetate produced by approaching the laboratory temperature during the critical stage, especially since the commercial acetate yield was so much lower than the laboratory results; (2) to determine if the increase in yield of alcohol produced by a control of the speed of the exothermic reaction could be duplicated on a large scale; and (3) to determine the economic application of any results obtained.

PART II—COMMERCIAL DISTILLATION

APPARATUS—A diagrammatic sketch of a commercial retort and setting similar to the one used in the test is shown in Fig. 3. The retort held two cars, each having a capacity of $2^1/_4$ cords, or a total of $4^1/_2$ cords of wood. The retort was fired at two points on one side and the hot gases passed along the bottom of the retort in opposite directions, up the sides and ends before passing up the stack. A and B were pyrometers placed in the top flue gases and the average temperature at these points was taken as the average temperature of the heat being applied to the retort. The pyrometer C was located in the center of the outlet pipe as close to the retort as the outer brick casing would permit and its readings were assumed to be the average temperature to which the distillation vapors had been subjected in the retort.

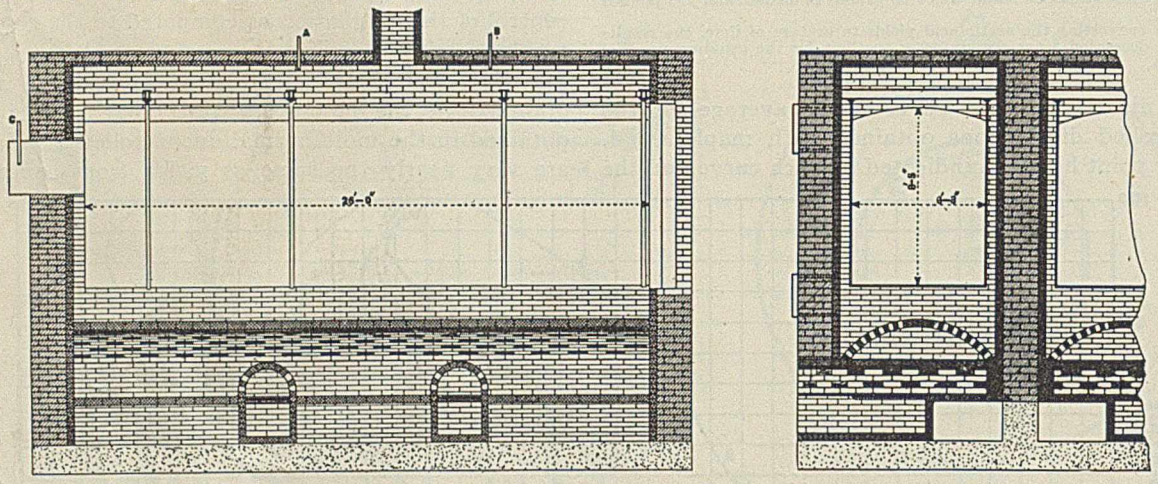

FIG. 3—EXPERIMENTAL COMMERCIAL RETORT

The retort was fired with soft coal and at certain periods with the uncondensable gases coming from some other retort. The experimental retort was one of a battery of ten, five of which supplied fuel gas to the other five during about 7 out of 24 hours.

MANIPULATION—The experiments were made while the entire plant was in usual operation and in order to determine the yields from the single retort the distillate was caught in 50-gal. barrels. The distillate was thoroughly mixed in the barrels and samples of equal volume taken from each. The mixed sample, therefore, represented an average of the entire distillate. This sample was analyzed[1] for alcohol and acetate by commercial methods of determining the yields of products in this manner.

The total amount of wood for each charge was weighed and the relative amount of each species determined and moisture samples taken.

At the outset it was of course evident that the practical value of the test depended on introducing no procedure that would reduce the efficiency of operation. Since an increase in the time of distilling seemed the most likely drawback, it was decided to vary the method of firing or change the manner of distillation only so as to insure that the run would be finished in the usual cycle of 24 hours. Without exception the retort was "pulled" at the end of that time.

The raw material consisted of 93 per cent maple, 4 per cent birch, and 3 per cent beech, as an average. It was in all cases 4-ft. cord wood ranging from 6 to 8 in. in maximum diameter. From 35 to 45 per cent of the dry weight of the wood was water, which was 10 to 20 per cent more moisture than the average distillation wood contains. In view of the necessity of adhering to the 24 hour cycle, the high moisture content materially shortened the time available for temperature control.

DISTILLATION—Observations of the temperatures produced by the usual method of firing were first made and the yields determined for comparative purposes.

With the apparent effect of the temperature of distillation as an explanation of the high yields of acetate in the laboratory, experiments were first made in which the critical distillation point was brought as nearly as possible to the laboratory temperature.

In the commercial test, where the heating medium is necessarily at a much higher temperature than that desired in the retort because of the large diameter to be penetrated, the critical stage could not be observed, except by the indication of tar in the distillate. All distillations were, of course, made from a hot retort,

[1] The methods of analysis were the same as those used in the laboratory tests.

the previous charge being "pulled" within two hours at most after finishing.

It was at once apparent that the temperature was not the important factor since the laboratory yields were not approached.

In attempting to carry the distillation within the low temperature range of the laboratory retort, it was found that the critical stage of the distillation proceeded very rapidly for a while, but had to be pushed hard at the end, in order to complete the run in 24 hours.

A series of runs was then made in which the method of firing was varied in several ways, in order to produce differences in the temperature at which the exothermic reaction took place and also the rate of distillation during the critical state.

RESULTS OF COMMERCIAL TESTS

The results of the different distillations on the commercial retort are given in Table II. The different runs were not made consecutively, but have been divided into groups including similar tests.

The results are given both in percentage of the unit weight of dry wood and in the commercial units, gal.

TABLE II—RESULTS OF COMMERCIAL TESTS TO DETERMINE THE EFFECT OF TEMPERATURE CONTROL ON THE YIELDS OF DISTILLATION PRODUCTS

	Lbs. wood per cord			Wood alcohol		Acetic acid		Charcoal	
Group No.	As used for tests	Free from moisture	% moisture(a) based on dry weight	% of wt. of dry wood	Gal. 95% alc. per cord	% of wt. of dry wood	Lbs. of 80% acetate (b) of lime per cord	% of wt. of dry wood	Lbs. per cord (20 lbs. to bu.)
1	4265*	3025	41.0	1.70	8.2	3.75	187	36.4	53.5(d)
2	4250	3025	40.6	1.99	9.56	4.05	201	34.2	51.75
	4120	3010	36.9	2.01	9.63	3.92	194	35.5	53.5
	4075	2910	40.0	2.09	9.67	4.03	188	34.7	50
Av.	4160	2982	39.2	2.03	9.62	4.03	194.5	34.8	51.75
3	4050*	2965	36.5	2.06	9.73	4.36	213	36.5	54.25
	4070*	2970	37.2	2.07	9.8	4.34	212	37.6	54.75
	4325	3000	44.4	2.16	10.32	4.15	205	37.2	56.25
	4060	2965	36.9	2.11	9.95	4.24	207	36.0	53.5
Av.	4125	2975	38.75	2.10	9.93	4.25	209	36.9	55.4
4	4175*	3000	39.2	2.18	10.42	4.24	209	37.8	56.5
	4040	3025	33.5	2.25	10.78	4.39	218	34.4	52
	4175	3000	39.2	2.27	10.80	4.33	214	37.4	56
	3860(c)	2805	37.7	2.30	10.27	4.45	205	34.7	49
Av.	4130	3008	37.3	2.23	10.66	4.32	213.6	36.4	54.8

(a) The moisture content of runs * were not determined but were estimated from runs with corresponding weights per cord that were determined.

(b) The acetate included 15 pounds per cord obtained from the settled tar by distillation.

(c) This run was not included in the average for this group as the charge consisted of very badly decayed wood, also shown in the light weight per cord. The curves for this run were the same as the average for the group. The yields in per cent of dry wood are seen to be the highest of any run but the light weight per cord brought down the yields on the cord basis.

(d) Estimated from a number of commercial distillations.

of 95 per cent wood alcohol and lbs. of 80 per cent acetate of lime per cord.

INTERPRETATION OF RESULTS—The results have been interpreted as in the laboratory tests by drawing the curve showing the relation between the percentage of total distillate and the temperature. These curves are shown in Fig. 2 for comparison with the laboratory tests. The curves are numbered to correspond with the groups and are the average of all the runs in that group. The curves designated Y show the relation between the distillate and the temperature of the vapors (indicated by the pyrometer C, Fig. 3) while the curves Z show the relation between the distillate and the heat applied to the retort (indicated by the pyrometers A and B, Fig. 3) for the corresponding groups. The results for the different groups are summarized in Table III.

GROUP 1—This is the usual commercial method of firing and has been described as "fast drying—fast exothermic reaction."[1] The method of firing to produce this kind of distillation is clearly indicated in Fig. 2, curve Z1. The temperature of the retort is raised continually until the destructive distillation point is indicated by the flow of distillate and the appearance of tar. The fire is then held steady for a while and then pushed at the end to "make charcoal." It should be noted especially that curve Y1 is very close to the general slope of B—the uncontrolled laboratory distillation.

TABLE III—SUMMARY OF EFFECT OF TEMPERATURE CONTROL ON THE YIELDS OF PRODUCTS

	Wood Alcohol		Acetate		Charcoal
Condition	Gals. 95% per cord	Increase over uncontrolled runs	Lbs. 80% per cord	Increase over uncontrolled runs	Bushels per cord
Laboratory uncontrolled....	7.50	..	261	..	...
Laboratory controlled.....	10.90	45	266	2	...
Commercial Group 1—Fast drying, fast exothermic...	8.2	..	187	..	53.5
Commercial Group 2—Slow drying, fast exothermic....	9.62	17.3	194.5	4	51.75
Commercial Group 3—Faster drying, slower exothermic than Group 2.....	9.93	21.1	209	11.8	55.4
Commercial Group 4—Fast drying, slow exothermic..	10.66	30	213.6	14.2	54.8

GROUP 2—In this group is shown the effect of bringing the distillation temperature as low as possible for as long a time as the cycle would allow. In curve Y2 it is seen that the distillation reaction went very rapidly after the tar point was indicated. These runs have been designated as "slow drying—fast exothermic." In all cases the rise in temperature is due partly to the exothermic heat and partly to the external fire but in this group much of the rapid sloping off of the curve is due to the exothermic reaction. In distillations of this kind the bottom of the retort became so hot that in practice this procedure would be impractical for continuous operation because of excessive depreciation.

Curve Z2 shows the manner of firing. It should be pointed out that the cold wood in the hot retort at the start takes up a large amount of heat and while the temperature of the fire was actually being lowered the normal quantity of fuel was consumed.

Compared with Group 1, the method of distillation showed an appreciable increase in alcohol and acid.

GROUP 3—This group is really a modification of Group 2 and is, therefore, described as "faster drying—slower exothermic reaction than Group 2." This is clearly seen in curve Y3. Curve Z3 shows that the retort was fired by allowing the temperature to fall slightly during the first part of the drying stage and then keeping the fire on a gradual rise until the last few hours when the temperature was increased more rapidly in order to insure good charcoal.

[1] Most of the curves Y up to the tar point simply indicate the removal of moisture from the charge. The moisture content of the different groups was as follows: (1), 41 per cent; (2), 39.2 per cent; (3), 38.75 per cent; (4), 37.3 per cent. These are close enough together to make the curves entirely comparable. An analysis of the distillate up to the tar point was made for one run in Group 3 and indicated 21.9 per cent of the total alcohol and 28.7 per cent of the total acetate obtained in the run.

A decided increase in yields over Group 2 is shown. In the light of the laboratory curves, this increase must be attributed to the slower exothermic reaction rather than the effect of temperature.

GROUP 4—The results obtained by the method of distilling used for this group prove conclusively the importance of the rate of distillation on the yields of alcohol and acid, since the highest yields are obtained in these runs. As shown by the curves, these runs were made by "fast drying and slow exothermic reaction."

Referring to curve Z4, it is seen that the drying period was accomplished by a rapid rise in temperature (or steady firing), and in this stage the distillation curve Y4 parallels curve Y1 very closely.

The important procedure in achieving this manner of distillation was the anticipation of the tar point as indicated in the bending back of the Z curve before the tar appeared. In practice, if the distillate can be observed as it flows from the end of the condenser, the time to lower the temperature of the fire would be noted by the first appearance of particles of tar, which precedes the true tar point by from one to two hours. When wood of a uniform moisture content was being used, this method might, however, be replaced by firing at a definite time period.

A comparison of curve Y4 with curve A of the laboratory-controlled runs indicates the similarity of the slopes of these curves, especially after the tar point.

FUEL—The fuel required in the different groups is given in Table IV.

TABLE IV—FUEL USED IN COMMERCIAL TEST PER CORD OF WOOD DISTILLED

Group No.	Coal Pounds	Gas Hours	Total fuel as coal Pounds
1	240	10	412
2	352	4	412
3	250	10	407
4	275	12	463

Owing to the variation in the length of time gas was used, the results, as actually measured, are not comparable. On the basis of one run made without gas, which required 412 lbs. of coal per cord, compared with Group 1, in which 240 lbs. of coal and 10 "hrs." of gas were used, 1 hr. of gas was taken as equivalent to 15 lbs. of coal per cord. Then on calculating the "hrs." of gas into coal for the different groups, the results are shown in the last column of Table IV under "total fuel as coal." On this basis, Group 4, which gives the highest yields of alcohol and acetate, would require the equivalent of about 50 lbs. more coal per cord. This would be practically negligible where waste wood was used as fuel, but with coal at $3.50 per ton it would amount to about 10 cents per cord additional fuel cost.

COMMERCIAL APPLICATION

In the commercial application of temperature control as developed in this preliminary study, an accurate method of measuring temperature would be required, and probably for successful operation also the employment of a head fireman. Economically the balance is apparently drawn between the cost of installing pyrometers, the employ of a day and night head fireman for at least each 50 cords per day distilled, and the additional small fuel cost per cord, as compared with a possible increase in yield of 25 lbs. of acetate and $2^1/_2$ gals. of alcohol per cord. Also the control distillations were shown to be possible within the time required for the usual cycle of operation.

CONCLUSIONS

It was shown in the small scale distillations that a lowering of the temperature of the process and decreasing the speed with which it took place gave marked increases in the yields of alcohol. Also the laboratory methods gave much higher yields of acetic acid than those obtained commercially but this yield was not greatly affected by varying the laboratory methods.

It is now seen in applying these variations in methods of distilling on a much larger scale that a change in the rate of distillation produces practically the same results on the yield of alcohol while the actual temperature of the reaction is not shown to be of as great importance. If it could be shown that the formation of alcohol in the destructive distillation reaction and its probable secondary decomposition into methane and carbon monoxide in the presence of the hot charcoal is reversible, the increase in alcohol by control of the reaction, allowing an accumulation of the end products, would be easily explained.

If the products after formation are lost by decomposition, the greater stability of alcohol after formation as compared to acetic acid seems evident since the large retort which probably involves many interreactions gives practically the same yields of alcohol as the small apparatus while the acid yield is much less than the laboratory yield.

Any process of approaching the high laboratory production of acetic acid will probably have to involve some method of preventing the interreactions in the large apparatus.

It is not improbable that still higher yields than those given can be obtained in the commercial plant with the application of temperature control alone. Thoroughly air-seasoned wood would require appreciably less time to enter into the destructive distillation stage, thus giving a better opportunity to lengthen the period of slow reaction. The drying stage would also not require so high a temperature at the end, thus bringing all but the last portion of the reaction into a lower range of temperature.

These tests are considered as a preliminary indication of the results that may be obtained from this interpretation of temperature control. The study of this phase is being continued by longer runs comprising an entire plant. Other phases of directing the destructive distillation reaction of wood to produce maximum yields of products are also being made by the United States Forest Products Laboratory.

SUMMARY

I—Destructive distillations of hardwood in the laboratory on 70-lb. samples indicated that lowering the temperature of the reaction and decreasing the speed of the distillation at the critical stage increased the yield of methyl alcohol 45 per cent.

II—The laboratory distillations gave 40 per cent more acetate of lime than commercial yields, but the acetic acid was not greatly influenced by variations in the method of distilling.

III—The application of the laboratory methods to a commercial retort holding $4^1/_2$ cords of wood indicated possible yields of alcohol 30 per cent higher than by the usual methods of firing and an increase of 15 per cent in yields of acetate of lime.

IV—The best results were obtained by slow distillation during the critical stage rather than by lowering the temperature at which the reaction took place. This was accomplished by rapidly removing the moisture content of the wood in the first stages, and then anticipating the period when destructive distillation or critical stage began. At this point the temperature of the fire was decreased.

V—This method of temperature control gave promise of being entirely applicable in the commercial plant. The fuel requirements were only slightly higher than the usual methods of firing and the cycle of operation was not changed.

VI—The studies of temperature control have shown that wood alcohol either exhibits sufficient stability in the retort or its formation is of a simple enough character to allow it to be easily effected and the amount recovered greatly increased. Acetic acid, however, is apparently much more subject to variations in the original wood decomposition and methods of preventing the many interreactions going on in the complex vapors of a large retort will be required to secure yields of this product that will more nearly approach the theoretically possible yields.

FOREST PRODUCTS LABORATORY, MADISON, WISCONSIN

THE DETERMINATION OF BENZOL IN GAS MIXTURES[1]

By G. A. BURRELL AND I. W. ROBERTSON

Received April 29, 1915

With the present great demand for benzol and the installation of plants at different places for obtaining this constituent, there has arisen a demand for a rapid method of determining the benzol content of gas mixtures. Hence a scheme follows which the authors have used in determining it in the carbureted mixed coal and water gas of Pittsburgh. Fig. 1 illustrates the apparatus. The bulb contains phosphorus pentoxide for removing water vapor. To start a determination the apparatus is connected to a vacuum pump and exhausted of its air: a Gerky pump will do. The gas mixture is then introduced at atmospheric pressure, the barometer read, and the two bulbs immersed in a mixture[2] of solid carbon dioxide and acetone or alcohol. After waiting about 10 minutes, as much gas as possible is withdrawn from the bulbs by means of the vacuum pump. The gases removed will be those of high vapor pressure at —78° C. In the case of the mixed coal and water gas the authors worked with, they are CO_2, O_2, CO, H_2, CH_4, N_2, C_2H_4, C_2H_6, C_3H_6, C_3H_8 and C_4H_8; in fact, practically all the gases except the benzol. Next the stopcock on the apparatus is closed, the cooling mixture removed, and the benzol allowed to vaporize at room temperature. Its pressure is then read on the side-arm mercury manometer attached to the apparatus. This pressure compared with the atmospheric pressure gives the percentage of benzol in the gas mixture. The results of two determinations are shown in Table I.

TABLE I—BENZOL DETERMINATION IN PITTSBURGH GAS

SAMPLE NO.	1	2
Original pressure of gas	744 mm.	744 mm.
Partial pressure of benzol vapor	10 mm.	9 mm.
PERCENTAGE OF BENZOL	$\frac{10 \times 100}{744} = 1.34$	$\frac{9 \times 100}{744} = 1.31$

To obtain other data on this method of separation, the distillate from the above freezing process was next passed into fuming sulfuric acid. In the case of Sample No. 1 there was obtained 7.32 per cent of illuminants, and in the case of Sample No. 2, 7.39 per cent. The total illuminants in the Pittsburgh gas, as found by absorption in fuming sulfuric acid, is 8.67 per cent. In other words, the benzol percentages as found when added to 7.32 and 7.39, respectively, equal 8.66 and 8.70 per cent, or almost identically the same quantities as the total illuminants in the coal gas.

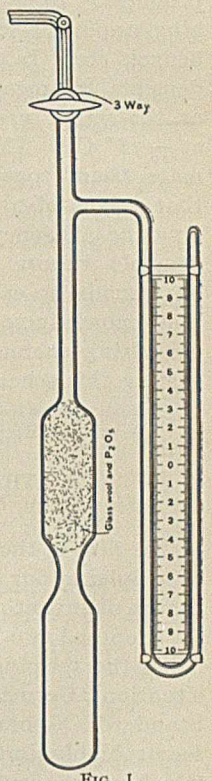

FIG. 1

Benzene reacts with oxygen as follows:

$$C_6H_6 + 7.5O_2 = 6CO_2 + 3H_2O.$$

The contraction is 2.5 volumes and the carbon dioxide is 6 volumes. Table II shows the results of analysis of the residual vapor that was held in the liquefaction bulb (Fig. 1) when the coal gas was cooled at a temperature of —78° C. Before analysis the benzol was diluted with air.

TABLE II—ANALYSIS OF BENZOL VAPOR

	Cc.
Volume taken for analysis	28.29
Oxygen added	51.94
Total volume	80.23
Volume after burning	75.47
Contraction due to burning	4.76
Volume after KOH absorption	64.25
Carbon dioxide produced by burning	11.42

It will be observed that the ratio of the carbon dioxide to the contraction is almost exactly 6 : 2.5, showing that the vapor obtained in the benzol determination was principally benzol. Traces of other easily condensible vapors may have been present but apparently in such small quantities as to be negligible.

The authors were unable to find, in the literature, the vapor pressure of benzol at —78° C., but apparently it is very small. Benzol boils at 80.12° C.: at —20° the vapor pressure is 5.76 mm.[1] The authors prepared saturated vapors of benzol by shaking the pure liquid with air. It was a simple matter to pre-

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

[2] This mixture gives a temperature of about —78° C. The solid carbon dioxide, obtained by releasing the gas from a commercial cylinder, through a cloth towel, is mixed with acetone or alcohol to the consistency of slush.

[1] Landolt and Börnstein Tables, **1905**, p. 143; according to Regnault.

pare unsaturated vapor by merely diluting the saturated vapor with air. The percentage of benzol was checked by combustion analysis. It was found that all of the benzol could be separated at —78° C.

The above tests show that as far as the Pittsburgh gas is concerned the method is satisfactory.

In extracting benzol from coke-oven gases (large-scale operations for this purpose are in progress), the gas is washed with a petroleum distillate, in which the benzol is dissolved, also toluol and other products. As a check on the efficiency of the scrubbing apparatus there is needed a rapid test for the benzol, etc. In this case, toluol or other easily condensible hydrocarbons would interfere with the test, as the vapor pressure of toluol is only 0.0058 mm. at —78° C.[1] The best one could do would be to estimate them together, along with any other vapors that might also be retained, so that the test would give the efficiency of absorption of all the easily condensible vapors in the scrubbing oil. The authors have made no experiments with coke-oven gas.

Acknowledgment is made to Dr. G. A. Hulett, consulting chemist to the Bureau of Mines, for suggesting this scheme of analysis.

LABORATORY OF GAS INVESTIGATIONS
BUREAU OF MINES, PITTSBURGH

THE POTASH SITUATION[2]

By EDWARD HART

The files of the Patent Office show that the question of supplying our own potash has greatly exercised the brains of inventors. Among the sources of supply so far proposed two have seemed to me of special interest. With the termination of the present highly artificial situation, German competition of the old-fashioned Standard Oil brand must again be encountered. It seems highly improbable that most of the processes which must depend for revenue upon the price of potash alone can be successful because the nature of the German source of supply is such as to give them an immense initial advantage.

A considerable amount of potash must in the near future come from cement fume. This appears to exist chiefly as sulfate. A sample, which I obtained from this source, contained 94 per cent sulfate and 5 per cent carbonate. The sulfur probably comes from the coal. The total amount obtainable from this source is problematical, of course, and it is questionable whether all the potash can be extracted, but if we place the amount recoverable as 0.4 per cent sulfate, the total amount obtainable would be in the neighborhood of 60,000 tons annually.

This cement dust has caused much annoyance and even serious loss in Northampton Co., Pa., and the adjacent districts and cement manufacturers recognize that condensation of this fume is one of the problems that must soon be solved. They also seem to be of the opinion that so far no practical solution has been offered. That this fume must be condensed is quite independent of any revenue to be derived from the material recovered. The dust recovered, only partly converted into cement, is worth, as cement material, but 75 cents per ton.

Another source that has attracted much attention is the potash of feldspar.

Arthur S. Watts has enumerated the feldspar supplies of the Eastern United States.[1] He has, however, omitted to mention the fact that a considerable amount of very fine potash feldspar is imported from Canada where it occurs in a great lens deposit, unlike any other deposit I have seen, about thirty miles north of Kingston. This deposit is not a pegmatite in the ordinary sense of that term. The spar occurs as a mass of uniform composition in a deposit which has been mined as an open cut, 40 feet in width, together with lump quartz of apparently good quality in a deposit of less width alongside of and partly surrounded by the spar. This deposit contains no mica. The mining cost of this material is very low, as very little cobbing is needed, but the cost of transportation to our markets is very high.

A study of the analyses quoted by Watts shows that very few orthoclase deposits run above 12 per cent K_2O, and as a matter of fact, I think 11 per cent is a much safer basis for such calculations. This corresponds to 220 pounds K_2O, 350 pounds KCl or 422 pounds K_2SO_4 per short ton of spar. Lump spar of this quality cannot be obtained at the mine at less than $3.00 to $3.50 per ton, f. o. b. car.

Many of the processes proposed contemplate the extraction as chloride by some modification of the J. Lawrence Smith method, using calcium chloride as the material for supplying chlorine. If we allow two cents per pound as the value of potassium chloride, a figure above the truth for normal conditions, and $2^1/_4$ cents for potassium sulfate (which may be produced in my own process) this would yield:

350 lbs. KCl at 2 cents	$7.00
422 lbs. K_2SO_4 at $2^1/_4$ cents	9.49

It is at once evident that the probability of profit from any process which contemplates only the extraction of potash from this material is very small.

In mining feldspar in most localities, only a small proportion of the material taken out can be classed as No. 1 spar, and very large refuse heaps accumulate which may contain as much as 9 per cent potash and 15 per cent alumina. In addition to this, not a few of the openings yield quantities of material so mixed with mica and still high in potash, as to be available for potash extraction, while quite useless as feldspar. It is from these materials, quite low in first cost, that our potash must be derived. Such material exists in quantity in the district near Erwin, Tenn., on the Carolina, Clinchfield and Ohio Railroad, where a plant is to be erected by the Clinchfield Products Company in the near future. This location has the advantage of proximity to supplies of cheap coal and barytes, both of which are needed in the exploitation of the process to be used.

Briefly, the process consists in heating a mixture of feldspar refuse and barytes in proper proportion in a

[1] Landolt and Börnstein Tables, **1912**, p. 394; according to Barker.

[2] Presented at the 50th Meeting of the American Chemical Society, New Orleans, March 31 to April 3, 1915.

[1] *Trans. Am. Ceramic Soc.*, **16** (1914), 80.

reducing atmosphere where a barium aluminum potassium silicate results containing about 36 per cent silica. This is run into water while molten and the granulated material ground and floated. The settled material is then treated as a paste with the proper quantity of sulfuric acid which decomposes it perfectly, giving a solution of alum and aluminum sulfate and a solid residue consisting of nearly equal parts of very finely divided barium sulfate and silica. It might be supposed that the silica would be so gelatinous as to be unwashable, but this has not been found true. On the contrary, where properly manipulated, the precipitate is somewhat granular, but entirely free from grit, and forms an excellent material, after ignition, for use as a pigment in printing ink, rubber incorporation and as a coating for paper. In value we believe this material will be found to be superior to very pure china clay. As you will see[1] from the sample submitted, it has a beautiful white color.

The solution, when evaporated, yields the potash as potash alum, and if the little iron present be kept in the ferrous condition, this alum, after washing with a little water and whizzing, is entirely free from iron and well suited for the preparation of pure potassium sulfate and iron-free alumina or aluminum sulfate, as desired. We expect to sell our alum as such so far as the market will take it and decompose only so much of it as may be necessary. This process may, therefore, furnish no potash at all. But inasmuch as potash for alum production now comes from over seas, this method is an indirect contribution to the supply.

The solution never contains enough potash to precipitate all the aluminum as alum. An excess of aluminum sulfate remains in the mother liquor together with the sodium and a little iron. This is allowed to cool and is broken up, furnishing a material equal in value to that now made from bauxite.

LAFAYETTE COLLEGE, EASTON, PA.

AVAILABILITY OF ORGANIC NITROGEN[2]

By J. E. BRECKENRIDGE

Received April 12, 1915

In the last few years this subject has been coming to the front very rapidly. In some of the northern states more unscrupulous manufacturers secured all their nitrogen in their 1 per cent nitrogen brands from garbage tankage and peat. The state control officials soon became aware of the practice and argued that the farmer was paying for first-quality readily active nitrogen and received an inert and less expensive nitrogen; in other words, the farmer was not receiving full value for his money. This fact led to a thorough investigation as to the methods by which the control people could identify the activity of organic nitrogen. Much criticism was made as to the rendering available of inert organic nitrogen such as horns, hoofs, hair, leather, feathers, fur waste, etc., by digesting in sulfuric acid. While it was believed possible, it was considered that manufacturers were not doing it.

This led to the appointing of a committee to arrange, if possible, for a visit to some factory to watch the process. Such arrangements were made. Samples of all materials which went into the mixing were drawn as they entered the mixer. One hundred and fifty tons were mixed, the den sealed by officials and allowed to stand 48 hours. Then the seal was broken, and in the presence of the state committee, the den was discharged and samples drawn. This sample was used to further investigate the methods for active organic nitrogen.

From this investigation came the publication of a pamphlet dated March 4, 1911, entitled "A Method for Examining the Activity of Organic Forms of Nitrogen," signed by the directors of the New York, New Jersey, and New England States Experiment Stations.

This pamphlet included instructions for carrying out the Alkaline Permanganate Method and results obtained by seven Experiment Stations' Laboratories on the three samples.

SAMPLE NO. 1 was base goods made from hair waste, treated sole leather, garbage tankage and sulfuric acid. The average test on this was:

	Per cent		Per cent
Total nitrogen	1.75	Water-soluble organic	1.01
Nitrogen as ammonium salts	0.25	Water-insoluble organic	0.49
Total organic	1.50	Active insoluble	0.21
		Inactive insoluble	0.28

The percentage availability of the insoluble by this method on this sample varied from 39.21 to 47.36 per cent, a difference of 8.15 per cent.

SAMPLE NO. 2 was made from blood (100 parts), cottonseed-meal (50 parts), acid phosphate (500 parts) and muriate of potash (75 parts). Average total nitrogen, 2.50 per cent. The percentage of available insoluble nitrogen varied from 61.11 to 77.97 per cent.

SAMPLE NO. 3 was made from treated sole leather (200 parts), garbage tankage (150 parts), peat (100 parts), acid phosphate (500 parts), and muriate of potash (50 parts). The average total nitrogen was 2.09 per cent. The percentage availability of insoluble nitrogen varied from 37.06 to 53.03 per cent.

The following forms for expressing results were suggested:

LONG FORM, to be used where nitrates and ammonia are present and determined:

Nitrogen as nitrates	Active insoluble organic
Nitrogen as ammonium salts	Inactive insoluble organic
Water-soluble organic nitrogen	Total nitrogen

SHORT FORM (where it is desired to shorten the above procedure):

Water-soluble nitrogen	Inactive insoluble organic
Active insoluble organic	Total nitrogen

We also have in this pamphlet a chart showing the comparison as to availability of insoluble nitrogen, of the results by the Alkaline Method and pot experiments.

This was the first instance of grading of quality of organic nitrogen by chemical methods. Jones of the Vermont Station had done much work on this and was the first to report this kind of work; he reported according to the long form, giving the water-soluble organic nitrogen, as well as the nitrates, ammoniacal,

[1] Samples of all materials were furnished for inspection.

[2] Chairman's Address, Fertilizer Division, 51st Meeting of the American Chemical Society, New Orleans, March 31 to April 3, 1915.

FIG. I—BLANK—NO FERTILIZER

FIG. II—NITROGEN AS SODIUM NITRATE

and insoluble nitrogen. His classification of the quality of the organic nitrogen was based on the water-soluble organic, plus the active insoluble, a reasonable and perfectly just and fair basis for classification.

Street, of Connecticut, carried on further experiments with the Neutral Permanganate Method and found that mixtures of acid phosphate and so-called high-grade ammoniates such as blood and tankage caused the neutral method to give lower results in such mixtures than in the materials themselves. On suggestion of the writer, sodium carbonate was added to the neutral permanganate solution just before adding the material to be analyzed, and the results on mixtures of acid phosphate and high-grade ammoniates were much more satisfactory. From this work came the so-called Modified Neutral Permanganate Method.

Both the Alkaline and Modified Neutral have been tried out by the A. O. A. C. and have been adopted, the Alkaline being adopted by the northern and middle western states and the Neutral being preferred by the southern states. Other methods have been suggested for determining the availability of organic nitrogen, such as "A Bacteriological Method for Determining Availability of Organic Nitrogen" by McCandless and Atkinson"[1] and "Bacteriological Method for Determining the Availability of Nitrogen in Fertilizers" by Dr. Lipman.[2] Neither of these methods have had any wide application because the Alkaline and Modified Neutral were much simpler and easier to manipulate.

From Vermont the use of the Alkaline Method has spread to Massachusetts, Maine, Rhode Island, New Jersey, Pennsylvania, Michigan and Indiana, with the probability of other states doing this line of work.

The Fertilizer Industry welcomes anything that will drive the unscrupulous manufacturers from the business, but does not welcome anything that causes unjust discriminations.

The interpretation of the results from any of these methods must be with a view to give justice to all classes of ammoniates. During the first of this work credit was given to the water-soluble organic nitrogen and the availability of the organic nitrogen was considered to be the water-soluble organic plus the active insoluble, which was a reasonable, just and fair ruling.

[1] THIS JOURNAL, 3, 174.
[2] *Ibid.*, 2, 146.

As an illustration of this, I quote the experiments of Hartwell and Pember[1] "average relative increase in yield (blood at 80 per cent) Base Goods nitrogen 84 per cent." This was on pot experiments where all the nitrogen of base was used. Another result was on the soluble part of Base, page 443 of above article—"soluble part of Base seems to have had an availability higher than blood, the insoluble part useless."

Taken as a whole, we have a material in the wet mixed base goods testing total nitrogen 1.68 per cent, soluble nitrogen 1.28 per cent, and insoluble nitrogen 0.40 per cent, which is rated by the above pot experiments as 84 per cent of the nitrogen available, but if rated on the insoluble portion, it is useless. The consumer in buying this quality of nitrogen is getting as much, if not more, for his money than he would if he bought blood nitrogen.

Again some pot experiments were carried out on millet and the accompanying cuts illustrate well the value of base goods nitrogen in comparison with no fertilizer, cottonseed meal and nitrate of soda, the amounts of fertilizer used representing the same amount of nitrogen ($1^1/_4$ lbs. per $^1/_{20}$ acre) in each case.

This subject is not one to be considered lightly whether or not it is believed that the methods employed are accurate. The facts are, these methods are being used and the fertilizer manufacturers should live up to these requirements as specified by the various states.

We have as the latest comments on this subject, the following:[2] "the use of low-grade and, therefore, cheap nitrogen supplies whose nitrogen by chemical treatment has been made useful for plant food, is laudable, provided the materials are sold for what they are, instead of being sold at the prices of nitrogen in high-grade nitrogenous ingredients."

According to this, the manufacturer is given no credit for gathering waste products and spending time and money in perfecting process and machinery which will handle such materials, but should sell such nitrogen at a cheap price because the crude materials from which he has obtained his nitrogen are cheaper than so-called high-grade nitrogen. It would be as reasonable to

[1] THIS JOURNAL, 4, 442.
[2] Pennsylvania Bulletin No. 259, page 20.

FIG. III—NITROGEN AS COTTONSEED MEAL

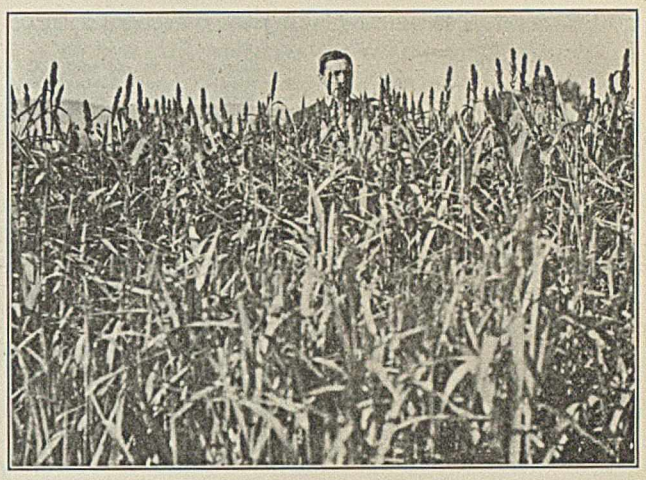

FIG. IV—NITROGEN AS BASE GOODS

say that sulfate of ammonia should be sold cheaper than so-called high-grade nitrogen, because it comes from coal and that is cheap.

I believe the Fertilizer Industry has been, and is willing, to coöperate along any lines which will promote progress, and it seems to me that the Fertilizer Division of the American Chemical Society has a work along the line of availability of nitrogen which is well worth serious thought.

CARTERET, NEW JERSEY

THE DESTRUCTIVE DISTILLATION OF PACIFIC COAST KELPS

By D. R. HOAGLAND

Received April 6, 1915

The giant kelps of the Pacific Coast have received considerable attention in recent years, because of their high content of potash and iodine. The production of these substances from kelp on a commercial scale was first suggested by Bâlch[1] and the studies were later continued by the Bureau of Soils.[2] A more extended chemical investigation, however, seemed essential, and was undertaken by this laboratory. The principal results and conclusions of this work are reported elsewhere.[3]

In order to increase the margin of profit in the kelp industry, attempts have been made to find some method of utilizing the organic matter in addition to the potash and iodine. Among the suggestions, destructive distillation was considered. It is the purpose of this paper to report experiments dealing with this particular phase of our investigations.

Balch compared the distillation of kelp with that of beech wood and states that the volatile products from kelp—acetic acid, methyl alcohol and tar—"may be regarded as approximating in value those of beech wood." He assumes a value of $6.00 per ton of dry material for the volatile products of distillation. Green and Johnson[4] afterward made two distillations of 3-lb. samples of nereocystis and expressed the opinion that the distillates were worthless, but no analyses or details were given. Turrentine[1] distilled a 3-kg. sample of *Macrocystis pyrifera* in a Hornsy rotary still. An analysis of the gas evolved is given, but no data regarding the distillates. Further experimentation seemed necessary in order to make a more definite valuation of the volatile products.

The distillations in this laboratory were conducted in an iron retort of about 1.5 gallons capacity. This was provided with a pyrometer and a suitable condenser. It is realized that distillation experiments on a small scale are not comparable with commercial practice, except to a limited extent. As a control, therefore, samples of oak and Douglas fir were distilled under identical conditions. It was hoped in this way to obtain a fair idea of the comparative value of the kelp. We believe such a comparison is permissible, especially since the yields of acid and alcohol for the oak and Douglas fir approximate those obtained in larger experiments on similar materials.[2] The methods of analysis were similar to those described by the U. S. Forest Products Laboratory.[3] The acetic acid was distilled with steam from a phosphoric acid solution.

Table I shows that the average yield of acetic acid was scarcely 0.2 that of Douglas fir and only 0.1 that of oak. The alcohol yields were in the same proportions. Tar oils to the extent of 4 to 7 per cent of the dry weight of the kelp separated out in the distillate. Most of the tarry material floats on the watery distillate. The tar oil analyzed as follows:

Sp. gr. at 17° C.	Distillation Fractions—Percentages 0 to 125° C.	125 to 250° C.	250 to 300° C.	Tar residue
0.984	11	27	23	39

The residue solidified to a hard, black, lustrous mass.

The kelp distillates were very slightly acid to litmus, but contained considerable amounts of basic substances. By the Kjeldahl method 3.2 g. of nitrogen were found in the total distillate from 1 kg. of dried kelp, approximately $^1/_4$ to $^1/_5$ of the total nitrogen contained in the material. It does not appear that ammonium compounds could be recovered from the liquors in commercially important quantities.

The gases evolved were not combustible during any of the early stages of the distillation, differing therein

[1] Balch, THIS JOURNAL, **1** (1909), 777.

[2] U. S. Senate Document, No. **190**.

[3] Burd-Calif. Exp. Station, *Bull.* **248**, and manuscripts in press by D. R. Hoagland and G. R. Stewart.

[4] Green and Johnson, *Chem. Eng.*, **15** (1912), 55.

[1] Turrentine, *Proc. Eighth Internat. Cong. Applied Chem.*, **15**, 313.

[2] Hawley and Palmer, *Proc. Eighth Internat. Cong. Applied Chem.*, **6**, 138; Benson, *Ibid.*, **25**, 331.

[3] Hawley and Palmer, *loc. cit.*

TABLE I—COMPARATIVE DISTILLATIONS OF KELP, DOUGLAS FIR AND OAK

No. of run	Grams of Materials Obtained Distillate: Moisture	Total	Less moisture	Settled tar	Charcoal	Gas by diff.	Total time of distillation Hrs.	% of dry wt. of material: Acid as acetic	Methyl alcohol 100%	Settled tar
ON 1 KG. OF KELP (*Macrocystis pyrifera*)										
3	116	290	174	..	465	245	3	..	..	..
6	116	255	139	..	465	280	2.5	..	..	..
9	116	265	149	..	500	235	12	..	..	..
11	116	262	146	48	485	253	3	0.34	Av.	5.4
12	116	283	167	41	512	205	3.75	0.49		4.6
13	116	277	161	60	472	251	4	0.28	0.14	6.8
14	116	242	126	37	487	271	4	0.28		4.2
15	116	217	101	30	515	268	8	..	..	3.4
23	116	277	161	60	485	238	4	0.49	0.20	6.8
24	116	305	189	55	460	235	8	0.58	0.18	6.2
ON 1 KG. OF DOUGLAS FIR										
16	190	414	224	60	260	326	3	1.5	0.7	7.0
17	190	424	234	80	276	300	2.5	..	0.7	10.0
25	190	450	260	100	300	250	4	1.6	..	12.0
ON 1 KG. OF OAK SAWDUST										
18	366	550	184	45	200	250	4	2.9	1.1	7.0
19	313	424	111	60	230	346	3.5	2.6	1.3	9.0
20	313	412	99	37	215	373	4.5	2.5	1.2	6.0

REMARKS ON DETAILS OF DISTILLATIONS

RUN NO. 3—Retort at red heat 1.5 hrs.
RUN NO. 6—Heated rapidly to red heat
RUN NO. 9—Very slow; low heat; 12 hrs.

RUN NO. 13
Started at 1.20 P.M.

Pyrometer readings	
1.45 P.M.	120° C.
2.00	160
2.30	200
3.10	220
4.05	240
gases slightly combustible	
4.30	360
gases burned steadily	
4.50	420
5.10	500
no more distillate	

RUN NO. 14—8.30 A.M.

9.15 A.M.	160° C.
large watery distillate	
9.30	200
10.35	220
11.15	280
gases slightly combustible	
11.30	310
distillate oily gas burns	
12.25 P.M.	500

RUN NO. 15—9.00 A.M.

9.30 A.M.	140° C.
9.50	170
10.45	190
12.00 M.	200
2.00 P.M.	220
2.15	290
3.20	390
4.30	400

RUN NO. 18—8.35 A.M.
Pyrometer readings

9.05 A.M.	170° C.
gases burn	
9.15	200
10.05	270
11.50	290
12.30 P.M.	530

RUN NO. 20—1.05 P.M.
Pyrometer readings

1.40 P.M.	160° C.
2.40	200
3.20	250
5.25	500

RUN NO. 24—8.35 A.M.
Pyrometer readings

9.10 A.M.	160° C.
11.00	230
12.45	250
1.00 P.M.	300
2.45	440
4.45	530

from the gases produced by the oak and fir. Turrentine gives the following data regarding the gases evolved in his experiment:

ANALYSES OF GAS SAMPLES FROM DESTRUCTIVE DISTILLATION OF KELP (MACROCYSTIS)—(TURRENTINE)

Sample No. Pyrometer	1 320° F.	3 480° F.	5 590° F.	7 900° F.
CO_2	80.0	70.0	44.0	20.2
Illuminants	2.0	4.0	10.0	3.3
O_2	0.5	1.5	0.8	0.5
CO	10.5	8.5	6.7	4.0
H_2	....	10.6	23.5	32.0
Methane	2.88	4.8	4.4	7.6
Nitrogen (by diff.)	4.12	0.6	10.6	32.4
Total per cent	100.00	100.00	100.00	100.00
Wt. per cu. ft.	0.106040	0.094	0.074150	0.057600
Cal. value	107.45	196.70	352.05	282.54

The charcoal residue was very soft and had a dull luster. A leaching experiment was made, using 2860 g. of charcoal, with an excess of distilled water. The solution was evaporated and three fractions crystallized out as is shown in Table II.

TABLE II—LEACHING AND FRACTIONATION

Fraction No.	Vol. of mother liquor	Wt. of dry salts Grams	Per cent of K_2O in salts	Per cent of I in salts	REMARKS
1	2600 cc.	450	58.0	0.03	Pure white crystals
2	1600 cc.	283	55.6	0.08	Nearly pure
3	860 cc.	252	47.3	0.17	white crystals
Mother liquor	...	368	19.1	1.46	

Per cent K_2O in 3 fractions combined = 54.6 = 86.8 per cent KCl.
Per cent of total K_2O recovered in 3 crystallizations = 88.
Per cent of total I in mother liquor = 87.

By passing the weak liquors over fresh portions of charcoal repeatedly it was found possible to leach out practically all of the potash and iodine with minimum quantities of water.

SUMMARY

1—Comparative laboratory distillations of kelp (*Macrocystis pyrifera*) with oak and fir were made. The data obtained did not indicate that the kelp distillates would have a commercial value.

2—Most of the potash may easily be recovered from the charcoal as a high-grade product.

DIVISION OF AGRICULTURAL CHEMISTRY
CALIFORNIA AGRICULTURAL EXPERIMENT STATION, BERKELEY

NOTE ON IDENTIFYING AMIDO-H-ACIDS

By BERNHARD C. HESSE

Received June 24, 1915

There are no published methods of identifying the 2-amido-H-acid, the 7-amido-H-acid and the 2,7-diamido-H-acid. H-acid is 1,8-amido-naphthol-3,6-disulfo acid. Ability to detect and differentiate these acids is frequently necessary for industrial purposes in obtaining light on the mode of making and the composition of certain coal-tar dyes.

The methods of identification described below were worked out with known H-acid and other materials and were successfully applied to disputed dyes; they are offered with confidence as to accuracy and conclusiveness so far as these three sulfo-acids are concerned. Corresponding mono- and di-amido derivatives of acids isomeric with, or analogous to, H-acid have *not* been similarly examined. Whether conflict exists in that regard has not been determined; this will call for further work by others. This note is not at all a notice of pre-emption but an invitation to others to enter this field. An analysis of the products worked on was not made; reliance for the constitution of these substances is placed solely upon the history and behavior of the materials employed.

The 2-amido-H-acid was made from H-acid by coupling it in hydrochloric solution with diazotized paranitranilin (one molecule), reducing and separating the acid product from the para-phenylene diamine; the 2,7-diamido-H-acid was made from the foregoing coupling product and a further molecule of diazotized paranitranilin, coupling in alkaline (carbonate), solution and treating this result as outlined above; 7-amido-H-acid was made from the coupling product of H-acid and diazotized paranitranilin (one molecule), coupled alkaline (carbonate); this product was reduced and separated as outlined above.

There is nothing new in the coupling methods used. The reducing and separation methods may be new. The general procedure was as follows:

Mix one gram of each of these coupling products with 10 cc. water, heat to 60° C., add one gram zinc dust thoroughly suspended in 5 cc. water, shake thoroughly, add 5 cc. of a 36° Bé. sodium bisulfite solution, shake thoroughly, gradually raise to a boil and maintain at boiling until further color-change does not take place; filter rapidly, cool, add 6 cc. hydrochloric acid (sp. gr. 1.16) to cooled filtrate; cool in a freezing mixture to 0° C. or below and maintain at that temperature until solid no longer separates out (this may take from half hour to 2 or 3 hours); filter upon paper through a Gooch; drain thoroughly; wash carefully with small amounts of saturated salt solution until drip is colorless

or almost so; wash with as little 95 per cent ethyl alcohol as possible (3 to 4 cc.), and follow with a wash of 1 or 2 cc. of ether; remove the solid from the filter paper and dry on a watch-glass at 90° C. The solid obtained is the amido-H-acid of the coupling product used. The same procedure applies to dyes from H-acid; if the dye-amount taken be less than one gram the proportion of reagents used should be altered to correspond.

The three identification tests used were as follows:

I—Boil a fraction of a milligram of the free acid with a few drops of 40 per cent caustic soda solution, dilute with 1 cc. water and note color produced; boiling the diluted solution may at times be necessary.

II—Place a fraction of a milligram of the free acid into 2 or 3 drops conc. H_2SO_4 (sp. gr. 1.84) and warm until it *begins* to turn violet; add one or two drops 0.5 per cent sodium nitrite solution; cool; dilute with 0.5 cc. water; cool (if a brown opalescence or turbidity appears here start all over again and do not heat quite so high); neutralize largely with 40 per cent caustic soda, finish neutralizing and make alkaline with slight excess saturated carbonate of soda solution; note color change.

III—Dissolve a fraction of a milligram of the free acid in one drop of saturated carbonate of soda solution, using heat if need be; add one drop concentrated hydrochloric acid, dilute with water to 0.5 cc., heat to boiling and cool; place a drop of this on good white filter paper; add right on top of it a drop or two of good hydrogen peroxide solution; when the color-development has reached its maximum, add a drop of 40 per cent caustic soda solution, preferably right on top of the other drops. Note color changes.

The behavior of these acids is tabulated as follows:

Test	2-Acid	7-Acid	2,7-Acid
I	Yellow or brown	Green	Violet going to blue
II	Blue-red	Blue-red	Yellow or brown
III H_2O_2	Brown or yellow	Violet to red	Blue
NaOH	Red	White or cream colored	Red to violet

By suitably combining these tests it is possible to detect all three of these acids in mixtures of 90 : 5 : 5 of any combination; with care, 200 mg. of H-acid-dye will answer to carry out this separation and all three of these tests. The colors produced by Test III can be photographed, *e. g.*, on a Lumière plate and the colors so preserved for reference; they are not stable, as such.

Condensation with phenanthrene-quinone is not satisfactory, calling for much time and care, and frequently failing where it should succeed; moreover, the amounts needed are very much larger than in the tests described; 2-amido-H-acid gives such a condensation product which is yellow, soluble in carbonate of soda and is precipitated therefrom by common salt and dissolves in concentrated sulfuric acid with a cornflower-blue color; the 2,7-diamido-H-acid does not yield such a condensation product under any practicable condition nor does the 7-amido-H-acid.

Acknowledgments are herewith made to Messrs. Read Holliday and Sons, of Huddersfield, England, for permission to publish this note.

90 William Street, New York City

INDIGOTIN CONTENT OF SOME JAPANESE INDIGOES[1]

By Shinjiro Sato

Received April 8, 1915

The analyses given below were made on commercial samples from the Province of Awa, where nearly all the Japanese indigo is produced. The remarkable features of the results are the low indigotin content and high ash. These are not surprising, however, when considered in relation to the methods of production, which have been modified but little since the introduction of indigo culture into Japan over two hundred years ago.[2]

In the native process the dried leaves of the *Polygonum tinctoria* are heaped on dirt floors, then thoroughly moistened with water and allowed to ferment. The piles are turned over from time to time, the whole process requiring about three months. The fermented mass, called "sukumo," is pounded up in large wooden mortars with mallets, then mixed with water and left to harden. The resulting cake is pressed and cut into cubes, called "tamas" ("Tama," Japanese word for "gem") in which form it is put on the market.

The above method requires much time and labor and yields a product of low indigotin content, since there is no extraction to separate the dye from the fiber of the plant. An extraction method applicable to Japanese conditions has been perfected by Dr. N. Nagai.[3] Although the method requires less time and labor than the older process and produces a superior indigo, it has not yet been generally adopted.

METHOD OF ANALYSIS

To test out the methods of analysis pure indigotin was first prepared, starting with Indigo S Pdr. furnished by the Badische Co. This was purified according to the method of Mönlau and Zimmermann,[4] by dissolving in 100 parts glacial acetic acid and 4 parts sulfuric acid, then hydrolyzing by diluting with water. The precipitated indigotin was washed, dried at 110°, and nitrogen determined by the Kjeldahl method.

	Found	Theoretical	
N	10.62 per cent	10.69 per cent	Indigotin 99.35 per cent

The method adopted for extracting and estimating indigotin is a modification of Rawson's procedure[5] in which he extracted indigotin by sulfonation and titrated with $N/50$ permanganate. The original method was modified by its author[6] and later by Bergtheil and Briggs,[7] whose procedure was adhered to exactly in the following analyses. The above methods for preparation of pure indigotin and for analysis of commercial indigos have been alternately criticized and defended.[8]

RESULTS OF ANALYSIS

Ash and indigotin are calculated on weight of dry

[1] Partial abstract of a thesis presented to the Faculty of the State College of Washington in part fulfillment of the requirements for the B.S. degree.

[2] History of Awa Indigo. (Published in Japanese.)

[3] Nagai, Lectures on Awa Indigo. (Published in Japanese.)

[4] *Zeits. Farb. Text. Chem.*, **10** (1903), 189.

[5] *J. Soc. Dyers and Col.*, **1** (1885), 74.

[6] *J. Soc. Chem. Ind.*, **35** (1906), 730.

[7] *Ibid.*, **18** (1899), 251; **25** (1906), 734.

[8] *Ibid.*, **26** (1907), 4, 182, 1172, 1174.

sample. In all cases duplicates represent separate extractions.

Sample	Per cent moisture	Per cent ash	Per cent indigotin
Purified synthetic indigo	....	....	99.71
		....	100.59
Awa indigo No. 1	9.71	27.75	6.78
	9.41	27.41	6.86
Awa indigo No. 2	9.18	27.28	5.05
	9.30	27.17	5.15
Awa indigo No. 3	10.08	30.56	4.23
	10.10	30.47	4.32
Awa indigo No. 4	12.44	32.39	1.94
	12.44	32.48	2.02
Awa indigo No. 5	9.24	33.89	1.26
	9.21	33.77	1.34
Awa indigo No. 6	11.56	34.50	2.46
	11.56	34.55	2.47
Awa indigo No. 7	9.92	34.34	3.17
	9.95	34.32	3.23
Awa indigo No. 8	9.46	35.26	3.59
	9.38	35.08	3.72
Indigo by Nagai process	3.18	33.25	31.45
	3.28	33.25	31.53

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EXPERIMENTAL DATA COMPARING THE DELICACY OF DIFFERENT TESTS FOR HYDROGEN PEROXIDE IN MILK

By Irwin T. Darlington

Received April 12, 1915

From references on the detection of hydrogen peroxide, the reagents listed in Table I were found to be in most general use and appear to give the most delicate tests for the detection of hydrogen peroxide in milk.

A stock solution of hydrogen peroxide was made from a commercial sample containing 3.2 per cent of

Table I

Reagent	Solution	Color in presence of H_2O_2
Starch	Dilute (water) + KI	Bluish green
Paraphenylene diamine	2 per cent (water)	Blue
Benzidine	4 per cent (alcoholic) + 10 cc. milk (+ 2 or 3 drops acetic acid)	Blue
Titanic acid	2 per cent solution titanium hydrate in dilute H_2SO_4	Yellow
Vanadic acid	2 per cent in dilute H_2SO_4	Faint orange-red

hydrogen peroxide by analysis with potassium permanganate. This stock solution was made so that each cc. contained 0.01 g. of hydrogen peroxide.

The milk to which the hydrogen peroxide was added was received from the city inspectors and was proven free from hydrogen peroxide by each of the above reagents.

Hydrogen peroxide was added to each 100 cc. of milk in separate bottles to the amounts indicated in Table II, and tests made on 10 cc. of each sample

Table II

Grams per 100 cc.	Results of tests made immediately after samples were made up															After standing 18 hrs. in a warm room		
	15.0	9.0	3.0	1.5	0.75	0.6	0.3	0.15	0.03	0.015	0.006	0.003	0.006	0.003	0.00105	0.00075	0.00037	15.0	9.0	3.0
Starch	+	+	+	+	+	+	+	+	+	+	+	+	+	+	—	—	—	+	—	—
Paraphenylene	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	—	+	+	—
Benzidine	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	—	+	—	—
Titanic acid	+	+	+	+	+	+	+	+	+	+	+	+	+	+	—	—	—	+	—	—
Vanadic acid	+	+	+	+	+	+	+	+	+	+	+	+	+	+	—	—	—	+	—	—

with each of the above reagents. Tests were made immediately after the samples were made up and again after standing 18 hours in a warm room.

It will be seen from Table II that paraphenylene diamine and benzidine proved to give the most delicate tests for hydrogen peroxide in raw milk. The limits of these two reagents proved to be 0.00075 g. of hydrogen peroxide n 100 cc. of raw milk. No experiments were made with milk that had been previously heated to destroy bacterial action.

Practically all the hydrogen peroxide was reduced after standing 18 hours in a warm room. This confirmed previous results obtained in this laboratory when it was found that after 18 hours' standing at room temperature no reaction could be obtained from the addition of 1 g. of magnesium peroxide to 100 cc. of raw milk. Positive tests were given only when the milk contained 9 per cent and 15 per cent of hydrogen peroxide.

The samples containing 9 per cent and 15 per cent of hydrogen peroxide failed to give a positive test with any of the above reagents, except paraphenylene diamine, which gave a delicate positive test with 15 per cent of hydrogen peroxide after standing in a warm room for 24 hours. Tests on distillates of milk treated with peroxide were negative.

A few tests were made with magnesium dioxide added as a preservative. The experiments made with this material were insufficient to afford any positive conclusions, but it appears that magnesium dioxide does not lend itself to as delicate tests as does hydrogen peroxide.

From the foregoing it is seen that paraphenylene diamine is the test of the reagents tested for the detection of small quantities of hydrogen peroxide in raw milk, and that it is probable that peroxide in amounts that would be added to milk as a preservative cannot be detected after 18 hours by these reagents.

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THE OFFICIAL METHOD FOR DETERMINING CRUDE FIBER AS APPLIED TO COTTONSEED MEAL

By C. K. Francis

Received April 7, 1915

The well known Weende method[1] for determining crude fiber has been subjected to criticism by many chemists. The chief trouble seems to be with the filtering materials, linen, asbestos, or glasswool, which vary in their physical characteristics and, necessarily, in filtering efficiency. In a number of laboratories it has been the practice to use linen cloth for filtering. The cloth has been used in the same manner as filter paper, with and without suction, in plain and in ribbed funnels. It has been difficult to duplicate linen of a selected pick, so that the fineness of the filter has been liable to vary from time to time. However, the method seemed to be satisfactory when working with such substances as corn, but when one endeavored to filter the alkaline mixture of certain seeds like flaxseed and cottonseed it became necessary to devise some scheme to hasten the process.

A novel arrangement for filtering the mixture through cloth by upward suction has been suggested by Pickel.[2] The cloth stretched over a funnel or thistle-tube furnishes a flat surface and the liquid passes rapidly,

[1] "Official Methods of Analysis," U. S. Bureau of Chemistry, *Bull.* **107** (Rev.), 65.

[2] This Journal, **2** (1910), 280; see MacNider, *Ibid.*, 281.

but the method appears to give results which are too low. Forbes and Menching[1] have proposed a method in which fine sand is used as a filter, but our tests with this material gave no results because the cottonseed meal mixture did not pass through even after 24 hours' continuous suction. Sweeney[2] has proposed to omit the first filtration and neutralize the acid with a known amount of sodium hydroxide, then to proceed with the alkaline treatment in the same vessel, and filter through asbestos. The method has been modified in a slight detail by Kennedy[3] and the procedure has been tested by several chemists in this laboratory. The results obtained for cottonseed meal were somewhat higher than when two filtrations were made.

While studying the methods for determining crude fiber our attention has been centered upon the filtering materials, and we have endeavored to select a filter which would be uniform. Slight modifications are suggested, and the work of several investigators, especially that of Sweeney, is taken into consideration in the directions given below. The specific details mentioned, it is believed, do not alter the principles involved in the official method, but on the other hand, suggest a procedure which permits a greater accuracy than the directions usually followed.

EXTRACTION OF FAT—Two grams of the meal are weighed into a glass extraction tube provided with a plug (about an inch square) of fat-free absorbent cotton in the bottom. More cotton is placed above the sample and a small copper wire spring inserted to hold the charge in place. After drying six hours at 105°, the meal is placed in the extractor[4] and extracted with dry ether for 16 hours. The excess ether is removed by suction, the tube and contents dried in the electric oven at 105°. The loss in weight is calculated to per cent of crude fat or oil.

CRUDE FIBER METHOD—The dry fat-free residue is carefully brushed, over white glazed paper, from the glass extraction tube into an 800 cc. lipless beaker, care being taken to remove any particles of the meal that may cling to the cotton plugs. Two hundred cc. of boiling 1.25 per cent H_2SO_4 are added and the mixture boiled for 30 minutes, using as condensers round bottom flasks filled with cold water on top of the beakers as shown in Fig. I: the flasks will fit closely if the beakers are round and have well-formed rims. A blast of air should be directed into the beaker when the foaming becomes serious. At the end of 30 minutes, 200 cc. of boiling 3.52 per cent NaOH are added and the boiling continued another 30 minutes.

Sweeney and others have proposed a sodium hydroxide solution of another strength but have included a separate neutralization, in the presence of an indicator, with a 10 per cent NaOH solution. A number of tests have indicated that a 3.52 per cent solution will neutralize the acid and leave a 1.25 per cent sodium hydroxide solution. Numerous titrations of this liquid were made showing the strength to vary from 1.25 to 1.27 per cent NaOH. According to the procedure outlined, one filtration is saved and there is no need to add an indicator and carefully neutralize.

A Buchner funnel, outside diameter 10.5 cm., is prepared with a 9 cm. S & S 575 filter paper. The paper should be moistened with water and pressed well into place, so that there are no holes uncovered and no open channels left about the edges. It is advisable to place a glass filter plate over the paper, to protect it and to prevent excessive packing of the fiber.

After the 30 minutes' boiling, the fiber should be filtered off rapidly with the aid of suction, washing with boiling water and then with a 1.25 per cent solution of HCl[1] (HCl 14 cc. made up to 500 cc.) until the washings are acid. Much time may be saved if the liquid is set aside for about five minutes to allow the fine material to settle so that the clear liquid may be decanted. When this has been done it has not, so far as we were able to determine, influenced the final results. The fiber should be washed with hot water until free from chlorides, and finally the filter should be washed several times with alcohol. The residue on the paper will be almost free from water and may be transferred to a prepared[2] Gooch crucible

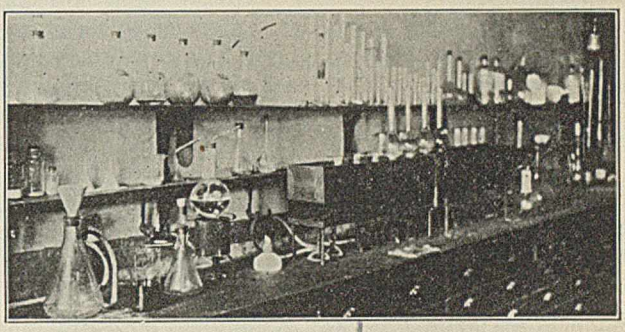

FIG. 1—CRUDE FIBER APPARATUS

with the aid of a spatula and a small amount of 80 per cent alcohol.

The crucible is placed in an oven heated to 105–110° C. for 2 to 6 hours, cooled and weighed. Materials containing much fiber may require heating for the longer period, and a second drying and weighing may be necessary in order to get the weight constant, but many determinations show a constant weight after heating for 2 hours. When dry the crucible is partially covered and incinerated at a low red heat for 15 minutes or until a white or light gray ash is obtained; it is then cooled and weighed. The loss in weight may be calculated as crude fiber.

EXPERIMENTAL

The tests described in the first part of this paper were made on the same sample of cottonseed meal. The quantity weighed for analysis was two grams, unless otherwise stated. All results are in terms of

[1] This Journal, **5** (1913), 258; Ohio Agricultural Experiment Station, *Bull.* **255** (1913).

[2] U. S. Bureau of Chemistry, *Bull.* **137** (1910), 157.

[3] This Journal, **4** (1912), 600.

[4] Francis, *Ibid.*, **3** (1911), 673.

[1] C. Kennedy, *Loc. cit.*, uses H_2SO_4 here but we prefer HCl, because the chlorides are easily detected and removed; moreover, dilute solutions of HCl may be quickly prepared.

[2] A porcelain or platinum Gooch crucible may be used. The crucible is prepared with a pad of asbestos, about 1 mm. thick, and heated to redness for fifteen minutes. When cool, fit the crucible into a suction filtering tube and transfer the material to it.

crude fiber calculated to per cent of the original material. The composition (except fiber) of the meal used in the experiments is shown in Table I.

TABLE I—PERCENTAGE COMPOSITION OF MEAL

Moisture	Ash	Crude protein	Crude fat
9.32	5.09	45.44	7.07

TESTING THE ASBESTOS—A test was made to determine the effect of digesting the asbestos, used for filtering, in acid and alkali and igniting before use. Portions of the same sample were treated alike with the exception that one lot was filtered through prepared asbestos[1] while the untreated asbestos was used for the second lot. The results with the untreated asbestos were 1.3 per cent higher than those obtained with the prepared asbestos.

It appeared that the crude fiber should be completely burned at comparatively low temperatures, and that extra heating in the flame of the blast burner should not be necessary. In Table II the results of a test

TABLE II—LOSS DUE TO EXCESSIVE HEATING OF THE ASBESTOS

Crucible No.	Wt. cr. + asbestos ignited over Bunsen flame for 3 hrs.	5 hrs.	Loss Gram	Ignited 3 min. in blast flame	Loss Gram
22.....	17.8641	17.8616	0.0035	17.8553	0.0063
21.....	17.6653	17.6645	0.0008	17.6575	0.0070
24.....	17.1209	17.1191	0.0018	17.1098	0.0094
19.....	18.0400	18.0395	0.0005	18.0310	0.0085
10.....	17.8555	17.8548	0.0007	17.8479	0.0069
16.....	17.7495	17.7487	0.0008	17.7400	0.0087

are shown in which quantities, 1.3 grams to 2.4 grams, of prepared asbestos were ignited to a constant weight and then placed in the blast flame for 3 minutes. This asbestos was used in blank determinations and consequently, subjected to action of the acid and alkali.

A separate test of the prepared asbestos was made to determine the loss due to heat alone, that is, without having to consider any influence the reagents might have on the final loss. For this purpose portions weighing from 0.5 to 2.2 grams were dried to constant weight and then placed in the blast flame for 3 minutes.

TABLE III—CRUDE FIBER IN COTTONSEED MEAL AS DETERMINED BY THE ONE-FILTRATION METHOD AND DIFFERENT FILTERS

Kind of filter	Per Cent Crude Fiber Determinations			Av.	Remarks
Linen.....	8.57	8.58	8.54	8.56	No suction; res. washed into a Gooch.
Hard paper..	9.54	9.53	9.37	9.48	S & S 575, 9 cm. in Buchner funnel.
Asbestos....	10.87	10.81		10.84	Filter in a Hirsch funnel.

The loss was from 8.8 to 33.2 mg., respectively, or a percentage loss of 1.85, 1.64 and 1.49 when calculated on a basis of the weight of the asbestos. When calculated as crude fiber, this loss represents 0.44, 0.76 and 1.66 per cent.

The fibrous material present in feeds is of such a nature that it should be completely incinerated after a few minutes (say 15) in the flame of a good burner, and ignition at high temperatures will tend to increase the loss which is calculated as crude fiber. In the fourth column of Table II, the weights are shown to be constant, excepting the material in crucible No. 22. Further loss, shown in the last column, obtained in the blast flame is probably due to some action on the asbestos or volatile salts present and certainly not anything closely related to cellulose or fiber.

FILTERING MATERIALS—The data presented in Table III show, to some extent, the loss that may take place with different kinds of filters when but one filtration is made.

Every precaution was taken in each test to wash free from alkali, acid and chlorides. The linen used was of good grade, having 38 threads to the sq. cm. The paper was hard filter paper, S & S No. 575, diameter 9 cm.

In Table IV are shown results obtained with the same sample of cottonseed meal, when two filtrations were made. For this experiment the regular 1.25 per cent acid and alkaline solutions were used according to the official methods.

It will be observed from a study of the data in Tables III and IV, that the determinations with a given filter appear, when considered alone, to be satisfactory. When comparisons of the groups are made, it will be seen that the results do not agree.

Determinations in addition to those reported here have shown that the loss with linen depends upon the number of times the mixture is filtered through it, thus demonstrating that there is a loss of crude fiber. The high results in Table III with asbestos have been explained under Table II, as being caused by the asbestos losing weight during the ignition process, and that the loss fluctuates with the quantity of asbestos used.

The crude fiber determinations in which filter papers were used appear to be the most uniform for both methods as indicated in Tables III and IV. The paper filters certainly do not permit any solid matter to pass into the filtrate, and they offer a uniform filter which may be easily obtained and from which the residue can be readily transferred.

Some determinations were made in which asbestos was used for both filtrations according to the official method, but the large quantity of material added to the second filter in this way caused the filtration to proceed very slowly, and introduced an additional error which may have resulted from any loss of weight of the asbestos.

PROTEIN REMOVED—An analysis of the residue remaining on the filter paper after the acid digestion, showed a protein content of 5.75 per cent. The final residue, chiefly crude fiber, contained 0.38 per cent protein. The crude fiber extracted from another meal was found to contain 0.35 per cent protein. This amount confirms the results obtained by Cross and Bevan, Tollens and others,[1] when working with the

TABLE IV—CRUDE FIBER IN COTTONSEED MEAL AS DETERMINED BY THE TWO-FILTRATION METHOD AND DIFFERENT FILTERS

Kind of filter 1—After acid digestion	2—After alkali digestion	Per Cent Crude Fiber Determinations			Av.	Remarks
Linen	Linen	8.44	8.16	7.96	8.19	No suction; residue washed into a Gooch crucible.
Linen	Asbestos	8.56	8.82		8.69	Asbestos filter in a Gooch crucible, *i. e.*, small amount asbestos used.
Linen	Asbestos	8.96	8.79	9.02	8.92	Asbestos filter in a Hirsch funnel, *i. e.*, large amount asbestos.
Paper	Paper	9.63	9.53	9.51	9.56	S & S 575 paper in a Buchner funnel.

[1] Asbestos which had been digested in HNO_3, NaOH and H_2O; also ignited in a furnace. This asbestos was used wherever asbestos is mentioned.

[1] *Cellulose*, 1 (1895), 101.

ordinary methods for determining crude fiber. No doubt any good filter will retain approximately the same quantity of protein, pentosans and volatile ash known to be present in crude fiber.

TESTS ON CELLULOSE—Two samples of filter paper were prepared from S & S paper No. *597*. One sample, designated *coarse paper*, consisted of large pieces, each about the size of one-quarter of a 9 cm. paper. All samples for the coarse paper work were dried at 105° C. until the weight became constant. The second sample, here called *fine paper*, was made

TABLE V—ACTION OF CRUDE FIBER REAGENTS ON PURE FILTER PAPER
Coarse Paper, Not Pulverized

On Paper Filters				On Asbestos Filters			
Weight of sample Gram	Fiber Recovered Wt. in gram	Per cent on Sample basis	Per cent on Ash + H_2O free basis	Weight of sample Gram	Fiber Recovered Wt. in gram	Per cent on Sample basis	Per cent on Ash + H_2O free basis
ACID DIGESTION ONLY				ACID DIGESTION ONLY			
0.6333	0.6230	98.37		0.5766	0.5705	98.94	
0.5551	0.5496	99.01		0.6229	0.6315	101.38	
0.6084	0.5967	98.08		0.5506	0.5589	101.51	
Average,		98.49	99.31	Average,		100.61	101.44
ALKALI DIGESTION ONLY				ALKALI DIGESTION ONLY			
0.6250	0.6018	96.29		0.5579	0.5531	99.13	
0.5903	0.5664	95.95		0.5456	0.5386	98.72	
0.5829	0.5558	95.35		0.5390	0.5304	98.40	
Average,		95.86	96.66	Average,		98.75	99.58
ACID AND ALKALI				ACID AND ALKALI			
0.5227	0.4595	87.95		0.5493	0.4863	88.53	
0.5657	0.4955	87.59		0.5271	0.4667	88.54	
0.5569	0.4867	87.39		0.5535	0.4902	88.56	
Average,		87.64	88.36	Average,		88.54	89.28

from the same kind of paper ground so as to pass a 40-mesh sieve. Both samples were boiled in the acid and alkaline solutions so as to determine the action of the reagents. In Tables V and VI the procedure is indicated. The words, *acid only*, serve to show that the portions were boiled in 1.25 per cent sulfuric acid for one-half hour, then filtered through paper, washed, dried, weighed, ignited and weighed. The treatment with alkali was similar except that 1.25 sodium hydroxide was used. The digestions in both reagents were made as outlined in the method suggested when but one filtration is to be used, and, also, according

TABLE VI—ACTION OF CRUDE FIBER REAGENTS ON PURE FILTER PAPER
Fine Paper, Pulverized to Pass 40-Mesh Sieve

On Paper Filters				On Asbestos Filters			
Weight of sample Gram	Fiber Recovered Wt. in gram	Per cent on Sample basis	Per cent on Ash + H_2O free basis	Weight of sample Gram	Fiber Recovered Wt. in gram	Per cent on Sample basis	Per cent on Ash + H_2O free basis
(1) ACID DIGESTION ONLY				(*a*) ACID DIGESTION ONLY			
0.3130	0.2939	93.90	99.42	0.2166	0.2191	101.15	107.14
0.1528	0.1452	95.03	100.62	0.2091	0.2144	102.53	108.56
0.1821	0.1722	94.56	100.11	0.2288	0.2228	97.38	103.10
Average,		94.49	100.05	Average,		100.35	106.27
(2) ALKALI DIGESTION ONLY				2(*a*) ALKALI DIGESTION ONLY			
0.2180	0.1991	91.33	96.70	0.2112	0.2071	98.06	103.86
0.1630	0.1504	92.27	97.72	0.1955	0.1927	98.52	104.38
0.1388	0.1274	91.78	97.17	0.2145	0.2118	98.74	104.59
Average,		91.79	97.20	Average,		98.44	104.28
(3) ACID AND ALKALI: 1 FILTRATION				3(*a*) ACID AND ALKALI: 1 FILTRATION			
0.1485	0.0964	64.91	68.75	0.1993	0.1425	71.50	75.71
0.2321	0.1501	64.67	68.47	0.1934	0.1445	74.71	79.13
Average,		64.79	68.61	0.2193	0.1601	73.00	77.30
				Average,		73.07	77.38
(4) ACID AND ALKALI: 2 FILTRATION							
0.4437	0.2885	65.02	68.85				
0.4082	0.2667	65.58	69.18				
0.4432	0.2848	64.26	68.05				
Average,		64.95	68.69				

to the directions of the official methods, which require two filtrations.

When considered alone, the action of the acid on the coarse paper is very slight and the alkali does not seem to dissolve a very large quantity, but when the acid digestion is followed by an alkaline digestion the loss is very material. The total loss, shown in Table V, through the paper filter is 11.64 per cent; the loss through asbestos is not so large, 10.72 per cent. In each test with asbestos filters the amount of fiber recovered appeared to be larger than with the paper filters, but it has been demonstrated that there is a compensating error here on account of the asbestos losing weight.

The results with tests on fine paper are given in Table VI.

Digestions of the fine paper in alkali, and in both acid and alkali resulted in greater losses than those of coarse paper. These experiments confirm the results shown in Table V regarding the influence of the treatment in acid (1) on the subsequent action of the alkali (3). There is practically no loss in acid, but a small loss in alkali (2), yet a large loss when the material is acted on by both acid and alkali, (3) and (4).

The quantity of fine paper recovered after digestion in alkali only, or in acid and alkali was much less than when the coarse paper was used. This indicates that samples should always be reduced to a fair degree of fineness.

Tests (3), (4) and 3(*a*), Table VI, are supposed to give the same results. The good checks obtained for (3) and (4) show that the one-filtration method will give equally as good results as the regular two-filtration method.

As cottonseed meal contains a quantity of lint, corresponding to fine paper, it may be fair to assume that the actual amount of crude fiber in the ordinary meal is much larger than will be found by the official crude fiber method. Suppose the results with paper filters in Table III and those in Table IV are correct, giving about 9.5 per cent crude fiber, then this amount represents 68.6 per cent of the total quantity of fiber present—see Table VI, (3) and (4). By simple calculation the total fiber becomes 13.8 per cent, and, therefore, 4.3 per cent is soluble or digestible.

SUMMARY AND CONCLUSIONS

1—A method is proposed for determining crude fiber in feedstuffs in which filter paper is to be used as the filtering medium, and which requires but one filtration.

2—Loss of crude fiber may occur when linen is used as a filter.

3—Asbestos may lose weight and thus introduce errors, causing the results to be too high. The error depends upon the weight of asbestos used.

4—The solvent action of 1.25 per cent sulfuric acid on practically pure fiber (filter paper) is negligible.

5—The treatment in sulfuric acid has an influence on the subsequent action of the alkali.

6—Coarse paper dissolves to the extent of 3.44 per cent during the 30 minutes' boiling in 1.25 NaOH, while fine paper dissolves to the extent of 2.8 per cent.

7—When filter paper is boiled in both acid and alkali, the loss with coarse paper is 11.64 per cent and with fine paper 31.4 per cent.

8—The proposed one-filtration method, with hard filter paper, gives more reliable results than those commonly obtained by the present official method for crude fiber.

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THE APPARENT EFFECT OF ACETIC ACID UPON THE CONSTANTS OF BUTTER FAT

By CLARENCE BAHLMAN

Received April 23, 1915

During the course of a chemical and bacteriological examination of Cincinnati's ice cream supply carried on by the laboratory of the Cincinnati Department of Health,[1] it became necessary to examine each sample for percentage of milk fat as well as to determine the presence or absence of foreign fats and oils.

The careful attention required for the estimation of fat by the laborious Roese-Gottlieb method would have made it impossible to examine more than a few samples each day. By the use of a simpler method, the laboratory helper was enabled to arrive at the fat content of 20 or 30 samples within one hour's time.

By this method,[2] 9 grams of the melted ice cream are weighed into the ordinary 10 per cent Babcock milk bottle, 20 cc. of glacial acetic acid added, and the mixture thoroughly shaken: 10 cc. of Babcock sulfuric acid are then added and the bottle again shaken. From this point the sample is treated by the ordinary Babcock method for the estimation of fat in milk. The reading of the fat column in the neck of the bottle, multiplied by two, gives the percentage of butter fat.

With this technique, the charring effect of the sulfuric acid upon the sugar is eliminated. The separated fat has a clear, pale yellow color, is free from sediment and foam, and distinctly separated from the lower acid layer.

As a test for foreign fats and oils, a few drops of the clear fat from the Babcock bottles were placed in the Zeiss butyro-refractometer and the refractive index determined at 40° C. With this instrument, pure fat from cows' milk will give, at 40° C., a reading falling between 40.5 and 44.5 scale divisions.

Practically all of the readings upon the samples, however, were well below the minimum figures for pure butter fat. As a general rule, the readings varied from 38.0 to 41.0, with a few running as low as 36.5 scale divisions.

Since it appeared highly improbable that all of our ice cream manufacturers were practicing adulteration, and in view of the fact that the food chemist places such great reliance upon the refractometer, the abnormal results shown by the samples were the subject of further study.

EXPERIMENTAL

One of the most suspicious samples was selected and about 15 grams of fat isolated, both by ether extraction and by the acetic acid Babcock method. The fat obtained by the latter method was taken from the necks of the bottles with a pipette and filtered through paper.

The fat separated by ether extraction gave results for refractive index and other constants which agreed with those for a pure butter fat. The fat obtained by the acetic acid method, however, gave low readings for refraction value and decidedly high Koettstorfer and Reichert-Meissl numbers, although a normal Hanus iodine figure was obtained.

It would appear from the above that when butter fat is separated from dairy products in the presence of acetic acid, the constants are materially altered. The following experiments were undertaken to determine whether such abnormalities were to be attributed to complex changes or merely to mechanical retention of the acid.

EXPERIMENT I—Nine grams of rich cream of known purity were placed into each of 15 Babcock bottles and 20 cc. of glacial acetic acid added. After mixing, 10 cc. of Babcock sulfuric acid were added and the bottles centrifuged as usual. The separated fats were drawn off, combined, and filtered through paper.

Fat was also separated from the same cream by the usual Babcock method of adding 17.5 cc. of sulfuric acid to 18 grams of cream.

After standing in the refrigerator over night, the well-known constants for butter fat were determined, with results shown in Table I.

TABLE I

Fat obtained by	Babcock method	Acetic acid method	
Refractometer reading, 40° C.	41.8	39.4	
Hanus iodine number	28.9	29.1	
Koettstorfer number	227.0	242.0	[226.0]
Reichert-Meissl number	28.3	44.4	[27.2]
Soluble acids	6.0	8.9	[5.6]
Insoluble acids	86.9	85.6	

It was found that 5 grams of the fat obtained by the acetic acid method retained acetic acid equivalent to 1.9 cc. *N* NaOH. Such acidity would have no effect upon iodine absorption nor upon the weight of insoluble acids, and consequently the two samples gave practically identical results for these determinations. The other constants, however, are based upon alkalimetrical principles and acid held by the fat would naturally affect the results. The figures shown in brackets in Table I were obtained by correcting for the amount of acid retained by the fat.

It will be seen that the corrected results vary from those given by the fat separated by the Babcock method only by amounts that can be attributed to experimental error.

It appears, then, that butter fat obtained by the ordinary Babcock method will give normal results for all of the usual determinations, while fat separated in the presence of strong acetic acid gives results apparently abnormal which, however, become normal when we take into account the acidity due to retained acetic acid.

EXPERIMENT II—Hydrochloric acid is also used for the separation of fat from dairy products. Like acetic acid, this also is a volatile acid and might be expected to be retained by the fat, affecting the results as in the case where acetic acid is used.

Eighteen-gram portions of cream were mixed with

[1] See *Amer. Jour. of Public Health*, **4** (1914), 1009–1015.
[2] Lichtenburg, THIS JOURNAL, **5** (1913), 786.

20 cc. of concentrated hydrochloric acid in Babcock cream bottles. The bottles were immersed in boiling water for 5 minutes, after which the fat was separated

TABLE II

Fat obtained by	Babcock method	Hydrochloric acid method
Refractometer reading, 40° C.	41.8	41.8
Koettstorfer number	227.0	228.0
Reichert-Meissl number	28.3	29.0

by the Babcock centrifuge, filtered, and compared with the fat obtained upon the same cream as in the regular Babcock method. The results are shown in Table II.

Hydrochloric acid, therefore, was not retained by the fat to any appreciable extent, 5 grams having an acidity equivalent to only 0.5 cc. of 0.1 *N* NaOH. The Koettstorfer and Reichert-Meissl figures were practically identical with those obtained when using sulfuric acid for the decomposition.

EXPERIMENT III—In order to further show that acetic acid is the only acid retained to a sufficient extent to affect the refractive index and other constants of butter fat, three samples of pure butter were melted and the filtered fat treated by shaking in a separatory funnel with such volumes of water and acid as approach the proportions of each present in the analysis as ordinarily carried on. The quantities used were as follows:

a—Babcock Method: 15 cc. melted fat, 30 cc. water, 40 cc. concentrated sulfuric acid.

b—Hydrochloric Acid Method: 15 cc. melted fat, 90 cc. hot water, 100 cc. concentrated hydrochloric acid.

c—Acetic Sulfuric Acid Method: 15 cc. melted fat, 30 cc. water, 100 cc. glacial acetic acid, 50 cc. concentrated sulfuric acid.

After shaking thoroughly for 3 minutes, the fat was allowed to come to the top, filtered, and cooled in the refrigerator. The refractometer readings were then taken upon all, and the Koettstorfer and Reichert-Meissl numbers upon a few, of the samples. The results were compared with the constants obtained upon the untreated fats, as shown in Table III. The refractometer readings were also taken upon the fat treated with acetic acid, after standing for certain time intervals in an air oven at 90–95° C.

This table indicates that abnormal results are obtained only in the case of fats separated in the presence of acetic acid. Such results are due to acetic acid being mechanically held by the fat. There is no acetylization. The fat obtained by the acetic acid method after thorough washing to remove acidity and treating as in the determination of the acetyl value, but without acetylating with acetic anhydride, gives results which do not differ from those upon the untreated fat.

The refraction reading and other constants are the most erratic when the greatest amount of acetic acid is present, but approach nearer to the correct results as the acid is gradually volatilized. One hour's heating at 90–95° C. is necessary to drive off all of the acetic acid, after which normal figures for all of the determinations may be obtained.

TABLE III—RESULTS FROM TREATMENTS OF PURE BUTTER

Sample No.	Determination	Untreated	Treated as in Babcock method	Treated as in HCl method	Treated as in Acetic Acid Method Heated at 90–95° C.				
					Not Heated	1/4 hour	1/2 hour	1 hour	2 hours
1	Refractometer	40.7	40.6	40.6	36.9	38.7	39.7	40.6	40.6
	Koettstorfer	226.0	..	227.0	..	..	..	226.0	..
	Reichert-Meissl	29.7	..	29.4	39.5	..	..	29.3	..
2	Refractometer	42.0	42.0	42.0	38.8	40.2	41.0	42.0	..
	Reichert-Meissl	...	..	...	41.6	..	..	28.2	..
3	Refractometer	42.9	43.0	42.9	39.8	41.6	42.8	42.9	..

CONCLUSIONS

I—Fats separated from dairy products by decomposition with sulfuric or hydrochloric acid will give the correct results for all of the usual determinations without any further treatment.

II—Fats separated in the presence of acetic acid will retain this acid and cause erroneous results. The acid is retained mechanically and must be entirely removed by drying for one hour at 90–95° C. before proceeding to determine the constants.

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STUDIES IN SYNTHETIC DRUG ANALYSIS
IV—ESTIMATION OF PHENACETIN AND SALOL IN ADMIXTURE

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Received April 7, 1915

INTRODUCTION

In the course of certain analytical work on medicinal tablets, we were considerably handicapped for a time through lack of a quantitative method for estimating phenacetin and salol in admixture. Accordingly, efforts were directed first to their separation and second to their individual determination. It was found that a satisfactory separation could be effected by treatment either with dilute sulfuric acid or with sodium hydroxide of definite concentration, followed by extraction with chloroform.

The separation proper, therefore, follows two distinct lines of procedure, involving on the one hand the acid hydrolysis of phenacetin, on the other the alkaline hydrolysis of salol. In the first instance, the direct estimation of phenacetin only is contemplated, the salol being determined by difference in all cases where the combined weight of both constituents is known or can be conveniently ascertained. In this procedure, the phenacetin is temporarily converted into phenetidine sulfate and acetic acid, while in the case of salol partial volatilization results during the process of digestion. The phenetidine salt, by virtue of its insolubility in chloroform, is readily freed from further contaminating salol by treatment with that solvent, then by means of acetic anhydride and sodium bicarbonate reconverted into phenacetin, the latter being subsequently isolated and weighed.

In the case of alkaline hydrolysis, the salol is first converted into sodium salicylate and phenolate,

from which the phenacetin is easily separated and subsequently recovered by extraction with chloroform. The salol is thereupon treated in rotation with standard bromine solution in excess, hydrochloric acid, potassium iodide and sodium thiosulfate. The principal reactions involved in the process and which serve as the basis for the calculation of results are:

$$HOC_6H_4CO.OC_6H_5 + 3NaOH = NaOC_6H_4CO_2Na + C_6H_5ONa + 2H_2O$$

$$C_6H_5OH + 4Br_2 = C_6H_2Br_3OBr + 4HBr$$

$$HOC_6H_4CO.OH + 4Br_2 = C_6H_2Br_3OBr + 4HBr + CO_2$$

$$C_6H_2Br_3OBr + 2HI = C_6H_2Br_3OH + HBr + I_2$$

$$I_2 + 2Na_2S_2O_3 = 2NaI + Na_2S_4O_6$$

from which it follows that 12 atoms of bromine are expended on every atom of salol and that titration of the iodine liberated by the unexpended bromine affords sufficient data for the estimation of salol.

FIRST METHOD—ACID HYDROLYSIS

PHENACETIN—If the sample is in pill or tablet form, ascertain the weight of 20 or more, reduce to a fine powder and transfer to a small tube or specimen bottle which can be kept tightly closed with a cork or glass stopper. Weigh out on a small (5.5 cm.) tared filter an amount of the sample equal to, or a convenient multiple of, the average weight of such pill or tablet, wash with successive small portions of chloroform, in quantity about 40 cc., sufficient at least to insure the complete extraction of all the phenacetin and salol present in the mixture. Collect the solvent in a tared 100 cc. beaker, evaporating by means of a blast to apparent dryness. During this operation, the beaker may, with advantage, be allowed to stand on a warm plate (50–60°) without danger of undue loss of solid substance. Permit the beaker to remain 24 hours in the open at the ordinary temperature, weigh several times until practically constant, then transfer the crystalline residue, by dissolving in and washing with sufficient chloroform, to a 50 cc. lipped Erlenmeyer, evaporate solvent by means of a blast and gentle heat, add 10 cc. dilute sulfuric acid (1 : 10) and digest at full steam-bath heat until the liquid is reduced one-half. Add 10 cc. of water, continue the digestion as before, add a second 10 cc. of water and evaporate to 5 cc. Transfer the residual liquid by pouring and washing with about 20 cc. of water to a small separatory funnel of the Squibb type and extract in rotation with 15, 10 and 5 cc. chloroform, washing each portion as obtained with 5 cc. water in a second separator, in order to recover traces of phenetidine sulfate possibly taken up by the chloroform, finally rejecting the latter, since it contains all the salol not previously eliminated during the process of digestion.

To the aqueous acid solution of phenetidine sulfate in the first separatory funnel, into which also the wash water from the second separator has been drawn, add sodium bicarbonate in small portions until an excess of this reagent persists at the bottom of separator after complete neutralization of the sulfuric acid. Now add 25 cc. chloroform and for every 100 mg. acetphenetidine or phenacetin known or believed to be present 5 drops of acetic anhydride, shake for some time vigorously, then pass the nearly clarified solvent into a second separator containing 5 cc. water, shake and receive the chloroform in a 200 cc. Erlenmeyer, first passing it through a small (5.5 cm.) dry filter. Distil at gentle heat about 20 cc. returning the latter to the first separator. Augment with 5 cc. fresh chloroform and repeat the extraction, washing and filtering as before, then collecting the solvent in the Erlenmeyer and again distilling until 25 cc. chloroform are obtained. With this portion make a third and final extraction, repeating the operations of washing, filtering and distilling to the point where about 5 cc. chloroform remain in the Erlenmeyer. Transfer this chloroformic residue by pouring and washing with sufficient fresh chloroform to a tared 50 cc. beaker or crystallizing dish, evaporate on a steam or vapor bath to apparent dryness, finally removing any pronounced excess of acetic anhydride by repeated addition of 1 cc. portions of fresh chloroform (to which a drop of alcohol has been added) and subsequent evaporation. Allow the nearly colorless crystalline residue of acetphenetidine or phenacetin to stand some time in the open, or better in a vacuum desiccator over lime, in order to eliminate the last traces of acetic anhydride. Weigh at intervals until constant.

SALOL—To ascertain the quantity of salol present in the sample, subtract the weight of phenacetin as found above from the combined weight of the two ingredients determined in the preliminary separation.

SECOND METHOD—ALKALINE HYDROLYSIS

PHENACETIN—On a small tared filter weigh out an amount of the sample containing not more than 100 mg. salol, exhaust with chloroform as in acid hydrolysis, collecting the solvent in a small lipped Erlenmeyer. Evaporate the chloroform by means of a blast and without applying heat. Add 10 cc. 2.5 per cent sodium hydroxide solution and heat 5 minutes on a steam or vapor bath at the temperature of boiling water. At the end of this period remove from bath and cool quickly to room temperature in running water in order to reduce to a minimum any tendency of the phenacetin to undergo partial hydrolysis. Transfer the liquid to a separatory funnel by pouring and washing with a minimum of water, finally rinsing out the flask with the first 20 cc. portion of chloroform used in extraction. Extract the aqueous alkaline solution with three 20 cc. portions of chloroform, washing each portion as obtained consecutively in a second separator with 5 cc. water, prior to passing the solvent through a small, dry filter into a 200 cc. Erlenmeyer, from which the combined chloroformic portions are distilled down to a residue of about 5 cc. Transfer the latter by pouring and washing with sufficient fresh chloroform to a small tared beaker or crystallizing dish, evaporate the solvent on the steam bath by the aid of a blast, cool and weigh the phenacetin at intervals until constant.

SALOL—Transfer both aqueous alkaline solutions from the separatory funnels to a suitable (500 cc.) glass-stoppered bottle, dilute with water to about 200 cc., run in from a burette an excess (about 45 cc.) of $N/7$ potassium bromide bromate, follow with 10 cc. concentrated hydrochloric acid, close flask and shake 1 minute, then at intervals over a period of one-half hour. At the end of this time add 10 cc. 15 per cent potassium iodide solution, agitating the closed flask at intervals for 15 minutes. Titrate the free iodine with standard thiosulfate (preferably $N/7$), previously adjusted to the standard bromine solution, 1 cc. of which is equivalent to 0.002548 g. salol. From the number of cubic centimeters standard bromine solution expended, calculate the salol on the basis of 12 atoms of bromine to 1 molecule of salol.

COMMENTS AND SUGGESTIONS

Tared filters for use in this and similar work may be conveniently prepared as follows: Fold, adjust in a small short-stemmed funnel, moisten and press carefully so that the entire rim of filter fits snugly to the glass. After drying, keep in balance case or other suitable dust-proof container, and when needed weigh on a small metal support or glass tripod. It is self-evident that all weighings with tared filters should be made as nearly as possible under comparable conditions. If, for example, the first weight is taken under a hygrometric reading of 50 per cent, the second weighing should be made under approximately similar conditions. This is indispensable when it is desired to estimate the quantity of chloroform-insoluble residue in phenacetin-salol tablets or other preparations likely to contain sodium bicarbonate, sugar, starch, talc or other more or less inert excipients. Experience has shown, however, that a variation in humidity up to 5 per cent at the time of the two weighings would not be productive of material error.

Before carrying out extractions in separatory funnels or introducing liquids therein, the valves should first be "locked" with a drop of water, otherwise losses from capillarity may result.

All distillations of chloroform should be carried out over a wire gauze or asbestos provided with a small opening and heated by a very small flame, the flask being connected with the condenser by means of a small spray trap, if available, similar to the type used in Kjeldahl work.

Phenacetin, being only moderately soluble in hot aqueous media, is accordingly somewhat difficult of hydrolysis. In order, therefore, to insure its complete conversion to phenetidine sulfate, special attention should be directed to the end that any visible particles of crystalline substance on the sides of flask during the early part of digestion should be gradually brought into solution by gently rotating the flask and, if necessary, by the occasional addition of a few drops of chloroform.

In order to facilitate the work and minimize errors due to recharging burettes, $N/7$ solutions are advocated in order that the volume of the thiosulfate required may not exceed the capacity of a 50 cc. burette. The thiosulfate solution is standardized against pure iodine. The strength of the bromine solution may also be determined by the aid of pure acetanilide.[1]

EXPERIMENTAL

The tabulated data given below are representative of results obtained by the authors in operations carried out on control and commercial mixtures substantially in accordance with the methods outlined above. A slight variation from the prescribed procedure should, however, be noted in the second series,

ACID HYDROLYSIS

SERIES 1

Phenacetin Gram	Salol Gram	Phenacetin recovery Gram	Phenacetin recovery Per cent	Salol recovery Gram	Salol recovery Per cent
0.1028	0.1159	0.1028	100.00	0.1159	100.00
0.1021	0.0996	0.1021	100.00	0.0996	100.00
0.1006	0.1048	0.1009	100.39	0.1045	99.71
0.1015	0.1015	0.1010	99.50	0.1020	100.49
0.1010	0.1044	0.1008	99.80	0.1046	100.19
0.1042	0.1004	0.1043	100.09	0.1003	99.92
0.1015	0.1001	0.1016	100.09	0.1000	99.90
0.1069	0.1186	0.1071	100.18	0.1184	99.83
0.1010	0.1174	0.1009	99.89	0.1175	100.09
0.0996	0.1014	0.0998	100.20	0.1012	99.79
0.1103	0.1036	0.1101	99.82	0.1038	100.19
0.2000	0.2000	0.1999	99.95	0.2001	100.05
0.1000	0.2000	0.0995	99.50	0.2005	100.25
0.2000	0.1000	0.2004	100.20	0.0996	99.60

SERIES 5

Sample(a) Gram	Phenacetin + Salol recovery Gram	Phenacetin recovery Gram	Phenacetin recovery Grains	Salol recovery Gram	Salol recovery Grains
0.4316	0.3256	0.1621	2.50	0.1635	2.52
0.4316	0.3253	0.1622	2.50	0.1631	2.52
0.4316	0.3257	0.1616	2.49	0.1641	2.53
0.4316	0.3273	0.1626	2.51	0.1647	2.54
0.4316	0.3276	0.1607	2.48	0.1669	2.58
0.4316	0.3268	0.1611	2.49	0.1657	2.56
0.4316	0.3268	0.1637	2.53	0.1631	2.52

ALKALINE HYDROLYSIS

SERIES 2

Phenacetin Gram	Salol Gram	Phenacetin recovery Gram	Phenacetin recovery Per cent	$N/7$ Koppeschaar solution Cc. expended	Salol recovery Gram	Salol recovery Per cent
....	0.0892	....	....	33.99	0.0882	98.88
....	0.0895	....	....	35.06	0.0891	99.64
....	0.0900	....	....	35.17	0.0894	99.37
....	0.0903	....	....	35.20	0.0893	99.12
0.0125	0.0914	0.0123	98.40	35.27	0.0897	98.13
0.0141	0.0915	0.0142	100.70	35.54	0.0904	98.77
0.0516	0.0513	0.0516	100.00	20.39	0.0518	101.10
0.0516	0.0512	0.0511	99.04	20.59	0.0523	102.30
0.0503	0.0499	0.0509	101.20	19.92	0.0506	101.50
0.0504	0.0508	0.0513	101.70	20.35	0.0517	101.77
0.0495	0.0499	0.0486	98.18	19.69	0.0501	100.40
0.0522	0.0516	0.0503	97.32	20.52	0.0521	100.97
0.0891	0.0884	0.0867	97.30	34.92	0.0890	100.67
0.1020	0.1020	0.1002	98.22	39.37	0.1003	98.33
0.1000	0.1003	0.0983	98.30	38.82	0.0989	98.63
....	0.0880	....	....	34.67	0.0883	100.30
....	0.0896	....	....	35.23	0.0898	100.20
0.0897	0.0892	0.0880	98.11	35.47	0.0904	101.30
....	0.1020	....	....	39.35	0.1002	98.32
0.0977	0.0999	0.0974	99.70	38.63	0.0984	98.55
0.1005	0.1008	0.0999	99.42	39.71	0.1012	100.39
0.0989	0.1012	0.0982	99.28	40.11	0.1022	101.00
0.1011	0.1009	0.1000	98.91	40.00	0.1019	101.00

SERIES 3

0.1006	0.1000	0.1002	99.60	39.48	0.1006	100.60
0.1039	0.1017	0.1011	97.31	40.00	0.1019	100.20
0.1015	0.1014	0.0987	97.25	39.69	0.1011	99.75
0.0995	0.1200	0.0981	98.60	47.11	0.1200	100.00
0.1012	0.1010	0.0995	98.33	39.64	0.1010	100.00
0.0982	0.0991	0.0966	98.37	38.76	0.0987	99.58
0.1023	0.1000	0.0998	97.57	39.12	0.0997	99.70
0.0996	0.1016	0.0972	97.59	39.86	0.1016	100.00
0.1037	0.0988	0.1013	97.68	38.78	0.0988	100.00

SERIES 4

0.1032	0.1014	0.1035	100.20	39.60	0.1009	99.54
0.1043	0.0978	0.1045	100.20	38.22	0.0974	99.58
0.1003	0.1011	0.0990	98.70	39.83	0.1015	100.40
0.0911	0.1012	0.0894	98.13	39.93	0.1017	100.49
0.0723	0.1015	0.0710	98.20	40.08	0.1021	100.59
0.0569	0.1020	0.0569	100.00	39.87	0.1016	99.61
0.0799	0.1002	0.0787	98.49	39.47	0.1006	100.30
0.0553	0.1092	0.0550	99.45	42.71	0.1088	99.68

SERIES 6

Sample(a) Gram	Phenacetin recovery Gram	Phenacetin recovery Grains	$N/7$ Koppeschaar solution Cc. expended	Salol recovery Gram	Salol recovery Grains
0.2700	0.1005	2.48	40.06	0.1022	2.52
0.2700	0.1002	2.47	40.15	0.1023	2.52
0.2700	0.1003	2.47	40.04	0.1021	2.52
0.2641	0.0982	2.48	39.08	0.0996	2.51
0.2641	0.0985	2.48	38.82	0.0989	2.49

(a) Average weight of single tablet 0.4316 g.

[1] *Bull.* **132**, Bureau of Chemistry, U. S. Dept. Agr.; *Proc. A. O. A. C.*, p. 198, footnote *b*.

ceedingly variable. In all the samples from grain the amount of charlock was invariably greater than that of brown mustard, ranging from 95.1 to 57.3 per cent as calculated to the pure wild mustard after correcting for foreign seed and impurities. A single sample of wild mustard from flax seed was almost absolutely pure brown mustard.

It should further be noted that the volatile oil obtained in the commercial samples was approximately proportional to the percentage of brown mustard present. This relation is so uniform that the volatile oil can be calculated from the botanical analysis with practically as great accuracy as by direct determination. For this purpose, the following formula based on the determinations made on the samples of the seeds separated from commercial wild mustard may be used:

$$V = 2.42\ B + 0.15\ C$$

in which V is the percentage of volatile oil, B is the percentage of brown mustard and C is the percentage of charlock. A comparison of the percentages of volatile oil found by analysis and as calculated by this formula in the samples of commercial wild mustard seed cleaned free of foreign seeds is given in the last column of Table I.

It can hardly be expected that a formula based on determinations made on only one sample each of brown mustard and charlock will give strictly accurate results in all cases, but the figures obtained on the samples examined by us show remarkable agreement and suggest further work both on wild mustard seed and the cake.

Determinations of volatile mustard oil in mustard flour may prove useful in estimating the approximate amount of charlock present as an adulterant provided this determination is supplemented by careful microscopic examination. It should not be forgotten, however, that in the presence of white mustard, which, like charlock, yields practically no volatile oil, or of black mustard, which may contain more than the brown, it would be impossible to arrive at a correct estimate from the volatile oil alone. Of special value in the case of such mixtures is an estimate based on the amount of hulls reacting with acid chloral hydrate solution.

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THE DETERMINATION OF SULFATES IN SOILS

By P. E. BROWN AND E. H. KELLOGG

Received February 15, 1915

In undertaking a study of the process of sulfofication or sulfur oxidation in soils, the first problem which arose was the selection of an accurate method for the determination of the sulfates. Wiley gives directions for the determination without comment as to any difficulties to be met with. As he describes it, the method merely calls for treatment of the soil with cold, dilute hydrochloric acid, filtration and precipitation with barium chloride and weighing the sulfate formed. In the work of the few investigators who have made observations on the formation of sulfates in soils, the method of extraction of the sulfates is usually not mentioned and when the point is considered worthy of notice, the rather indefinite statement is made that the soil is treated with dilute hydrochloric acid. Is it important that a certain strength of acid should be employed in order to accomplish complete extraction? What should be the length of time of contact with the acid? These are questions which immediately arise and the experiments reported here were carried out to answer them and to develop a method which would permit of an accurate estimation of sulfates as such in the soil.

EXPERIMENTAL

In the first experiments, therefore, 100-gram quantities of soil were shaken in the shaking machine for two hours with 200 cc. of 0.5, 1.0, 2.0, 5.0 and 10.0 per cent hydrochloric acid and with 200 cc. of water. A comparative series was run under exactly the same conditions except that 2 cc. of a 5 per cent solution of magnesium sulfate were added to each 100-gram quantity of soil. The amount of sulfate extracted in each case from the soil itself was thus determined and subtracting this figure from the total amount of sulfate obtained, the extraction from the magnesium sulfate added was found. The sulfates were determined in these cases by the usual gravimetric method using barium chloride. The results of these tests appear in Table I.

TABLE I—CONCENTRATIONS OF ACID VARIED

Lab. No.	Per cent HCl used	Grams $MgSO_4$ added	Milligrams S extracted as Sulfates Duplicates		Av.	SO_4 from $MgSO_4$	Milligrams sulfur Added as $MgSO_4$	Not extr. from $MgSO_4$ added
1, 2....	0.5	None	1.18	0.77	0.97	...	...	...
3, 4....	0.5	0.1	24.19	26.04	25.11	24.14	26.63	2.49
5, 6....	1.0	None	1.10	1.76	1.43	...	...	...
7, 8....	1.0	0.1	23.94	26.38	25.16	23.73	26.63	2.90
9, 10....	2.0	None	1.74	0.91	1.32	...	...	...
11, 12....	2.0	0.1	24.47	24.47	24.47	23.15	26.63	3.48
13, 14....	5.0	None	2.04	1.44	1.74	...	...	...
15, 16....	5.0	0.1	30.92	31.46	31.19	29.45	26.63	Excess
17, 18....	10.0	None	1.10	1.40	1.25	...	...	...
19, 20....	10.0	0.1	36.52	45.38	40.95	39.70	26.63	Excess
21, 22....	Water	None	4.00	4.12	4.06	...	...	...
23, 24.....	Water	0.1	30.70	30.34	30.52	26.46	26.63	0.17

Upon examination of these results it is found that treating a soil with hydrochloric acid in any of the strengths used did not permit of the determination of sulfates known to be contained in the soil. The weakest acid used allowed only a partial recovery of the sulfate added and as the concentration was increased up to 2.0 per cent acid the recovery became gradually smaller. With 5 and 10 per cent acid, however, the recovery was entirely too high, that with the 10 per cent acid being greater than that with the 5 per cent.

It is evident from these tests that there are some disturbing factors which prevent the extraction of sulfates from soils by hydrochloric acid. Van Bemmelen[1] observed that with hydrochloric acid much humus substance and iron oxide were dissolved and that these interfered with the determination of sulfates, causing low results. He found further that it was impossible to remove these substances without obtaining high results because of the oxidation of the sulfur in the dissolved organic matter.

Furthermore, with 5 or 10 per cent acid there is undoubtedly some solution of silica and this would make the results too high, as they have been shown to be.

It may be concluded, therefore, from these results

[1] *Landw. Vers. Sta.*, **37**, 284.

that dilute hydrochloric acid is quite unsatisfactory for the extraction of sulfates from the soil because of the ferric oxide and organic matter dissolved by the acid and because increasing the concentration of the acid makes the results too high on account of the interference of silica.

Examining the results where the soil was treated with water, it is found that rather complete extraction of the sulfates present in the soil was secured. Almost four times as much was extracted from the soil itself as with any of the hydrochloric acid solutions and the magnesium sulfate added to the soil was practically entirely recovered. Further tests to ascertain the efficiency of water for extracting sulfates were, therefore, planned.

In the first place it was deemed advisable to determine whether the amount of sulfates extracted from soil with water could be increased by longer periods of shaking. The same soil used in the preceding tests was, therefore, shaken for 2, 4, and 6 hours in the shaking machine and the results secured, which are given in Table II, show that just as much sulfate was extracted in two hours as in the longer periods.

TABLE II—EFFECT OF TIME OF SHAKING ON EXTRACTIONS

Lab. No.	Hours shaken	Milligrams sulfur as SO_4 in soil Duplicates		Av.
1, 2	2	3.42	3.51	3.46
3, 4	4	3.54	3.62	3.58
5, 6	6	3.04	3.64	3.34

It would seem, therefore, that the conclusion might be drawn that complete extraction of sulfates may be accomplished by shaking with water for two hours. It was felt, however, that in some cases quite considerable amounts of sulfates might be present in soils and in the sulfofication tests which it was purposed to carry out there was no doubt but that it would be necessary to encourage a rather large accumulation of sulfates to permit of the securing of definite data. Furthermore, magnesium sulfate, which was used in the previous series, is readily soluble, much more so than sulfates, such as calcium sulfate, more likely to be present in the soil. Consequently experiments were arranged to determine the ability of water to extract calcium sulfate from soils.

In the first tests, dehydrated gypsum was employed and the extraction with water was found to be quite incomplete, the discrepancies being rather large when the larger amounts of gypsum were used but still appreciable with the smaller amounts.

Gradually increasing the time of shaking with water permitted an increasing extraction of the sulfate, the largest proportion of that added being obtained when the period of shaking was eight hours. Still, however, the recovery was incomplete.

The same amounts of gypsum as were used mixed with the soil were shaken alone with water for varying lengths of time and the results showed that while mixing with soil retarded quite considerably the rate at which the sulfate went into solution in the water, the extraction was incomplete in the absence of soil even where only very small amounts of the gypsum were used. The pure, dehydrated gypsum used in this work has been found to be very much more difficultly soluble than the hydrated calcium sulfate and hence the tests were continued using chemically pure calcium sulfate containing two molecules of water. This compound is not only more readily soluble but it is believed to be more nearly like the compounds present in the soil than the dehydrated gypsum.

Tests of the solubility of the hydrated sulfate unmixed with soil showed complete solution in two hours' shaking. Varying amounts of the material were then added to the soil and the mixture shaken for varying lengths of time with water. The results given in Table III show that the extraction was complete in six hours. Other results using ground and unground soil showed that while the extraction was somewhat quicker in the ground than in the unground samples, shaking with water for 6–8 hours accomplished in all cases the complete extraction of the sulfate added. The amounts of sulfate added were much greater than would ordinarily occur in soils, and calcium sulfate is probably the most difficultly soluble of any sulfate which might occur in the soil. Hence the solution of this material in the amounts tested may be regarded as indicating that sulfates in the soil may be estimated readily by shaking with water for a period of six to eight hours.

TABLE III—EXTRACTIONS WITH WATER

Lab. No.	Grams $CaSO_4$ added	Hrs. shaken	Milligrams S extracted: As sulfates Duplicates		Av.	From SO_4 added	Mg. Sulfur Added as SO_4	Not extr. from sulfate added
1, 2	0.25	4	50.00	50.00	50.00	46.00	46.50	0.50
3, 4	0.25	6	50.72	50.46	50.59	46.59	46.50	....
5, 6	0.25	8	50.38	50.12	50.25	46.25	46.50	0.25
7, 8	0.05	6	13.36	13.12	13.24	9.24	9.30	0.06
9, 10	None	8	4.00	4.00	4.00	...	...	....

One point further was tested in this work and that was the use of the sulfur photometer. Gravimetric determinations of sulfates are very tedious and it was almost essential that a more expeditious method be employed if large numbers of determinations were to be made such as are necessary in studies of sulfofication. The photometric method was tested and compared with the gravimetric and it was found to be quite as accurate and much quicker. Its use for the determination of sulfates in soils should be strongly advised.

CONCLUSIONS

I—Sulfates cannot be extracted from soils by treatment with dilute hydrochloric acid because of the interference of organic substances and iron compounds.

II—Shaking soil with twice its weight of water in the shaking machine for six to eight hours extracts sulfates completely.

III—The sulfur photometer is a rapid and accurate means of determining sulfates.

LABORATORY OF SOIL CHEMISTRY AND BACTERIOLOGY
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COMPOSITION OF THE SALINES OF THE UNITED STATES. IV—A CORRECTION

By J. W. TURRENTINE[1]

Received January 28, 1915

Occasion having arisen for recalculating to the conventional combination the results in the analysis, in

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CORRECTIONS

Original analyses made by R. F. Gardiner except where otherwise noted

Bulletin No.	94 Pp.	J. I. E. C. 4 Pp.	B. S. No.	Ions: Na	Ions: Cl	Conventional Combinations: NaCl	$CaCl_2$	$MgCl_2$	Na_2SO_4	$CaSO_4$	$MgBr_2$	$MgSO_4$
	BRINES											
53(*a*)	4	831	13	100.8	..	258.0	..	...	....	..	...	..
..	5	...	14	..	..	..	..	5.5	....	..	1.2	..
..	6	...	15	..	..	..	..	4.7	....	..	1.3	..
..	7	...	16	104.0	171.6	264.3	..	5.9	....	..	0.9	..
						NaBr						
..	8	...	17	..	..	0.0	..	0.4	....	..	0.8	..
..	9	...	18	..	..	0.0	0.0	...	3.5	1.4	0.7	0.5
..	10	...	19	..	..	..	0.0	...	0.6	3.4	...	..
..	11	...	20	..	..	..	0.0	...	7.2	2.7	...	..
..	12	...	21	..	..	..	0.0	0.0	0.0	1.4	...	4.5
..	13	...	22	..	..	..	0.0	...	7.4	2.0	...	..
54	51	...	...	..	..	..	..	...	....	3.1	tr.	..
..(*c*)	61*a*	...	...	..	..	..	..	...	....	5.2	tr.	..
..	23	832	32	..	..	..	0.0	...	3.7	2.7	...	..
..	24	...	33	..	..	..	44.3	49.0	....	..	2.0	..
..	25	...	34	..	..	..	0.0	...	3.1	2.7	...	..
..	26	...	35	..	SO_4	0.0	0.0	...	3.0	2.0	...	..
..	27	...	36	..	0.6	..	..	...	....	..	...	..
55	138	...	...	..	..	NaCl	..	0.0	8.6	..	...	2.0
..	142	...	...	133.4	..	303.5	0.0	0.0	43.3	7.5	...	4.0
..(*c*)	149	...	...	..	..	NaBr	..	2.0	0.0	..	...	1.6
..	30	887	73	..	..	0.0	..	2.7	....	..	2.0	..
						NaCl						
..	31	...	74	92.2	..	234.3	5.5	12.9	0.0	36.8	2.3	..
..	32	...	75	Fe	NH_4	NH_4Cl	Fe_2Cl_6	12.1	....	..	0.6	..
..	34	...	77	0.8	0.3	0.9	2.3	...	....	..	...	..
..	35	...	78	0.8	..	..	2.3	...	....	..	tr.	..
..	36	...	79	..	..	..	..	14.5	....	..	2.3	..
..	37	...	80	..	SO_4	..	..	50.1	....	..	3.2	..
56	39	...	82	..	8.6	NaCl	..	...	....	12.2	0.2	..
..	40	...	83	..	..	146.4	..	23.9	....	..	2.3	..
..	43	...	86	..	..	NaBr	..	22.3	....	..	0.7	..
..	44	...	87	Na	..	0.0	..	3.1	....	..	1.8	..
						NaCl	$CaCl_2$					
(*d*)	45	...	88	117.7	8.0	299.2	0.0	0.8	0.0	3.4	...	7.0
						NaBr						
..	46	...	89	K	..	0.6	..	0.0	....	..	1.5	..
(*c*)	204	...	...	0.3	..	..	..	...	....	..	...	..
57	48	...	91	..	Br	..	..	5.1	....	..	0.8	..
..	60*a*	...	...	Na	0.1	NaCl	..	...	....	..	...	..
..	60*b*	...	...	53.3	..	135.5	47.4	10.2	....	..	0.3	..
..(*c*)	52	...	...	185.0	..	..	6.0	...	....	..	...	..
58	156	...	...	..	..	9.9	0.0	0.0	0.1	..	...	2.0
60	53	...	96	..	..	..	0.0	0.0	0.0	4.1	...	1.6
..	173	...	...	2.3	..	..	0.0	...	....	..	...	..
..	63	...	...	..	..	..	0.0	...	1.8	1.4	...	..
..	171	...	...	..	..	254.5	..	0.0	0.0	..	...	5.8
..	MOTHER LIQUORS, ROCK SALT AND SCREENED SALT											
61	57	832	48	56.8	..	..	..	...	....	..	...	..
..	61	...	38	..	Cl	..	..	7.8	....	..	1.3	NaBr
..	62	...	39	120.0	190.6	305.0	5.8	2.7	....	6.5	1.0	0.0
..	65	...	42	..	..	..	..	1.2	....	..	2.3	0.0
62	72	...	56	..	..	..	0.0	...	0.6	2.0	...	..
..	74	...	58	..	..	300.7	0.0	...	2.5	4.1	...	..
63	80	833	64	..	..	..	9.1	9.4	....	..	...	$MgSO_4$
..	86	...	70	..	..	..	0.0	5.9	0.0	2.7	...	4.4
..	87	...	71	..	..	256.5	0.0	35.2	0.0	1.4	...	12.8
64	89	888	98	75.2	200.8	191.2	..	34.9	....	..	5.1	..
..	90	...	99	64.7	204.1	170.5	..	41.1	....	..	3.8	..
..	91	...	100	..	CO_3	..	..	36.4	....	..	2.5	..
..	92	...	101	0.0	0.6	0.0	..	17.2	....	..	1.3	..
					Cl							
..	93	...	102	0.0	452.2	0.0	..	137.8	....	..	...	..
					CO_3				$CaHCO_3$	$CaCO_3$		
..	95	...	104	..	0.3	..	..	...	0.0	0.5	...	..
						NaBr			Na_2SO_4	$CaSO_4$		
..	96	...	105	..	..	2.2	0.0	0.0	3.3	2.0	3.0	..
..	97	...	106	..	..	NaCl	0.0	...	0.7	6.1	...	..
..	75	...	...	1.8	H_2O	4.6	..	...	....	..	0.6	..
(*e*)(*b*)	98	...	107	..	..	..	..	...	....	..	...	..
..	99	...	108	Ca	23.9	..	..	...	....	..	...	..
..(*c*)	5*a*	...	...	130.0	..	..	..	...	....	..	...	..
65	100	...	109	Na	Cl	..	..	18.8	....	..	...	..
..(*b*)	101	...	110	0.0	372.3	0.0	370.6	182.9	....	..	...	..
(*e*)(*b*)	103	...	112	..	..	..	..	...	....	..	...	..
..	13*a*	...	...	8.6	..	..	..	...	....	..	0.9	..
..	126	...	...	14.7	Mg	37.4	..	222.8	....	..	2.2	..
..	105*a*	...	1	..	0.1	98.3	0.0	0.0	0.4	0.7	...	0.5
..	108	...	4	38.8	..	..	..	0.0	0.0	..	...	1.3
..	111	...	7	38.3	SO_4	..	..	...	....	..	...	..
..	112	...	8	38.3	0.6	..	..	...	....	..	...	..
66(*g*)	21	...	...	..	..	..	..	...	....	..	...	..
..	114	...	...	..	Cl	48.5	33.5	...	0.0	7.1	...	..
..	117	...	...	..	53.9	..	..	...	....	..	...	..
(*f*)	116	...	...	..	..	..	..	...	....	..	...	..
..	118	...	...	..	..	74.2	0.0	0.0	8.9	..	...	16.8
..	...	5	11*b*	..	..	..	..	...	....	..	...	..
..	119	23	198	80.0	..	203.4	..	65.0	....	..	...	..
..	120	...	199	75.8	..	192.7	..	63.8	....	..	...	..
..	121	...	200	38.8	..	98.6	..	144.5	....	..	...	..
..	122	...	201	27.7	..	70.4	..	171.1	....	..	...	..
..	123	...	202	9.1	..	23.1	..	250.6	....	..	...	..
..	124	...	204	..	..	240.0	..	4.2	....	..	...	..
..	125	...	205	60.1	..	152.7	..	117.5	....	..	...	66.7

(*a*) A. R. Merz, analyst. (*b*) K only by Merz. (*c*) J. A. Cullen, analyst.
(*d*) From spring north of Woodward, Woodward Co., Okla. Collected by P. L. Clifton, 1910. (*e*) Data incongruous: withdrawn.
(*f*) Same as *Bull.* **94**, p. 54, No. 17 and THIS JOURNAL, **4**, 832, No. 26. (*g*) Values represent parts per 1000, not per cent.

this laboratory, of certain American salines,[1] numerous inaccuracies, inconsistencies and typographical errors have been discovered which it is our desire to correct. The analyses have been recalculated by Mr. A. R. Merz, with the collaboration of Messrs. Gardiner and Cullen who have, in each case, inspected the results or approved them without inspection. The more serious of the errors encountered are set forth in the

[1] *Bull.* **94**, U. S. Dept. of Agriculture, "The Occurrence of Potassium Salts in the Salines of the U. S." Extended abstracts, THIS JOURNAL, **4** (1912), 828 and 885; **5** (1913), 19.

table on page 688. Only the corrected figures and legends are recorded: reference is made to both publications, the first number being that assigned in *Bulletin* 94, and the second, the Bureau of Soils number assigned in articles which appeared in THIS JOURNAL.[1]

To report in the conventional manner the results obtained in the examination of the various brines submitted for analysis was a concession to the supposed wishes of the laymen interested to whom the statement of results as ions conveys but slight information. This concession was made against our best judgment, since to report the various basic and acid radicles as combined is to abandon for the moment the best conception of the state of salts in solution. To calculate such analytical data to the saline combination is to juggle figures. As the basis for the conventional combination the respective solubilities of the component salts, which anciently were regarded as entities, have been taken. This, likewise, is a false basis, since the solubility of each salt when alone in solution is different from its solubility when in solution with the other salts. The latter solubility is determined by the equilibrium conditions obtaining for each system studied. The conventional combinations should represent, if anything at all, the solids precipitated on evaporation from the system studied, and should be recorded in the order of their precipitation. This could be determined only by an examination of the system under consideration.

The value of the results previously published is scarcely diminished by the errors introduced in the calculations previously published. However, the fact that the system of calculation from ionic to saline form is based on erroneous conceptions and therefore itself is erroneous does not excuse avoidable errors in the application of the system. For that reason it is desired to substitute the recalculations herewith presented.

BUREAU OF SOILS, U. S. DEPARTMENT OF AGRICULTURE
WASHINGTON

[1] *Loc. cit.*

LABORATORY AND PLANT

A MODIFIED BURETTE CALIBRATING PIPETTE AND CERTAIN POINTS IN THE USE OF SUCH INSTRUMENTS[1]

By C. W. FOULK

Received March 23, 1915

Some months before this article was prepared for publication, the writer was told by the "Trouble Man" of a large chemical firm that the laboratory and factory control difficulties he was called upon to adjust were frequently caused by inaccuracies in the volumetric ware employed, and he added that in his opinion many young chemists and not a few old ones were unaware of this source of error. The "Trouble Man" must take the responsibility for his statement about chemists, but the author is willing to testify regarding the general depravity of uncertified volumetric ware. During the last ten years the calibration tables of several hundred burettes have been examined and errors of 0.1 cc. or more have been found the rule rather than the exception. Occasionally the corrections reach a truly surprising value. For example, at least three otherwise innocent looking burettes have been found with errors of over 0.4 cc. in the first 20 cc. of the scale. It, therefore, cannot be too strongly emphasized that all such measuring instruments must be calibrated before using.

If only one or two burettes are to be examined the method of weighing the water delivered from successive intervals is the simplest since it involves no special apparatus. If, however, a larger number are to be calibrated or if from time to time a few must be tested, some form of calibrating pipette will be found an advantage on account of the time saved and the simplicity and directness of the procedure. Several such pipettes have been described[2] but in every case an important point has curiously enough been overlooked, namely, the use of the two-way glass cock as an automatic zero adjustment. A modification employing this time-saving scheme will be described in this paper and in addition the general principles and procedures involved in the use and calibration of these calibrating pipettes will be given. It so happens that in previous articles there is not very good agreement as to the details of determining the capacity of the pipette itself and in some cases the methods of calculating the final values obtained for the different points on the burette scale are unnecessarily long. Many recent text-books also do not refer to the use of such calibrating instruments and, therefore, there is perhaps some justification for presenting in this place a more complete account of their advantages and use.

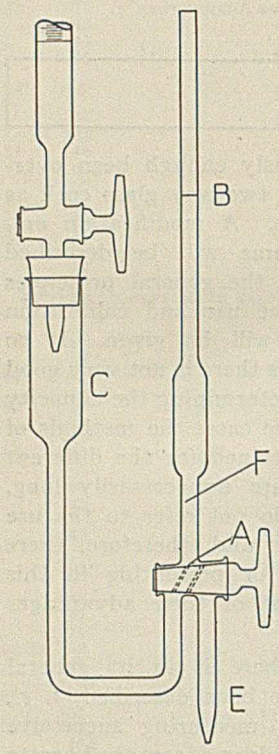
The instrument illustrated here is in its general operation like others that have been described, *i. e.*, it is a device for accurately measuring successive portions of water as they may be drawn from the burette under examination. It differs, however, from the previous instruments by its using the two-way glass cock as a zero adjustment instead of the usual mark on the lower stem. The enlargement at C may also be looked on as an improvement, since it furnishes a convenient place for attaching the clamp for holding it and also permits the use of a rubber stopper for connecting to the burette, which makes a more satisfactory joint than the gum tubing that would otherwise have to be employed.

All of the previously described pipettes of this sort have had a mark on the lower stem which served as a zero point, to which the water was adjusted before a portion was drawn out of the burette for measurement and at which the outflow was stopped when the pipette was emptied to make room for the next portion from the burette. The accompanying figure will illustrate this form of pipette if a mark around

[1] Pipettes of the design described in this article and provided with a 0.01 cc. division scale on the upper stem can be secured from the Kauffman-Lattimer Co., Columbus, O.

[2] Arndt, *Centralblat*, **1856**, p. 865; Scheibler, *J. prakt. Chem.*, **76** (1859), 177; Ostwald, *Ibid.*, N. F., **25** (1882), 452; Morse and Blalock, *Am. Chem. J.*, **26** (1894), 479.

the stem be imagined at F. That such a mark is redundant and that the two-way cock can serve as a self-adjusting zero can be seen by reference to the figure, in which the cock is represented in the position of allowing the flow of liquid to take place from the burette into the pipette. It will be seen that, if the pipette has previously been filled and emptied, the flow will begin at the top of the boring through the plug of the cock as indicated at A. Furthermore, since the operation of the cock is such that the connection with the burette is closed before the outflow through the tip can begin and the outflow through the tip is closed before the inflow from the burette can begin, it is evident that, after the pipette is emptied and another portion of liquid is to be drawn from the burette, its flow will also begin at the top of the boring at A and so on for all succeeding portions. This makes the point A a zero mark to which the adjustment of liquid is automatically regulated by the position of the cock. Moreover, this zero point is more accurate than a mark around the lower stem would be on account of the smaller diameter of the boring.



GENERAL POINTS IN THE USE OF SUCH CALIBRATING PIPETTE

First, there can be no question of the accuracy of the method. Owing to the smaller bore of the stem of the pipette the readings are ten times more delicate than on the burette. In other words, differences of 0.001 cc. can be noted in the pipette as readily as 0.01 cc. in the burette. An error might possibly be introduced by carelessly allowing a considerable difference in temperature to occur between the water as measured in the burette and in the pipette. Ordinary care will, however, prevent such differences so that it is safe to assume the temperature of the water to be the same —within the limits required by the nature of the work. A similar assumption is made by the Bureau of Standards in its method of calibrating flasks by delivering into them measured volumes of water from standard pipettes.[1]

Secondly, there can be no question of the time saved by the use of these calibrating devices because adjusting the meniscus in the pipette when drawing off a portion of water from the burette is a brief operation compared with making a weighing, and finally because there are no temperature corrections to calculate. The pipette when once calibrated for the standard temperature (20°) for glass apparatus, may be assumed to retain a constant volume so far as ordinary laboratory temperature changes are concerned.

[1] Osborn and Veazey, *Bulletin B. of S.*, **4** (1908), 589.

THE CALIBRATION OF THE PIPETTE

It is evident that the capacity of the calibrating instrument itself must be determined with great care and that this must be done by weighing the water required to fill it. From this weight and the temperature of the water its volume can be calculated. The methods for making such calculations are to be found in any large text-book on quantitative analysis and, therefore, will not be repeated here. In this connection see also the Bulletin of the Bureau of Standards cited above.

At the outset, however, an important point in the calibration of such pipettes should be noted: the usual rapid rate of outflow of the ordinary burette must be restricted or the results will be in error. This is because in calibrating the burette, successive, small portions (pipettefuls) are drawn off with an interval of time between the readings while in an actual titration 30 to 40 cc. may be drawn off at once. The former method gives more water because, being the slower, there will be more drainage.[1] The difference due to variable drainage may amount to as much as 0.1 cc. in the lower part of the scale in burettes as ordinarily received from the manufacturers. If, however, the rate of outflow be sufficiently restricted (see footnote below) this difference in drainage between emptying the greater part of the burette in a series of small portions or all in one portion, becomes negligible. In earlier articles this point has received no mention, though the method of Morse and Blalock eliminates the error. These authors, however, do not discuss or even allude to this advantage of their plan. The same situation exists in the case of calibrating a burette by weighing. If successive small portions are drawn off in tandem the results obtained for the lower part of the burette will differ from those obtained by starting at zero, unless the rate of outflow is small. The Bureau of Standards, though recognizing the small size of the error occasioned by the tandem method of calibrating burettes with restricted outlets nevertheless follows the more accurate plan of starting at zero each time when drawing off the portion of water to be weighed.

Similarly, the author prefers the Morse-Blalock method for getting the capacity of the calibrating pipette. It has the merit of eliminating any possible tandem-error and at the same time is, if anything, a trifle shorter than other methods. As will be seen below, it does not give the true capacity of the pipette but rather the capacity corrected for any difference in drainage between emptying the burette in successive, small portions taken out in tandem, as compared with drawing out the same amount of water in one portion; for example, 0 to 5 cc., 5 to 10 cc., etc., to 45 to 50 cc. as compared with 0 to 50 cc. in one portion.

Morse and Blalock's procedure is to determine the capacity of the pipette in an indirect way, by dividing the volume of water delivered directly from zero to a mark near the bottom of the burette scale, by the

[1] Schloesser, *Z. anal. Chem.*, **46** (1907), 392.

number of pipettefuls that can be drawn off to that mark. For example, with a pipette like the one shown here, the capacity of which is about 5 cc., it is evident that with a 50 cc. burette, 10 pipettefuls can be obtained if the capacity is less than 5 cc., or 9 pipettefuls if the capacity is a little more than 5 cc. Assuming the latter, let the reading of the burette be 45.23 cc. when the ninth pipetteful has been reached. To get the corrected capacity of the pipette, the burette is again filled to zero and the water allowed to flow out into a small flask to 45.23 cc. on the scale. This water is weighed, its temperature taken and its volume calculated. One-ninth of this is then the volume of the pipette to be used in calibrating burettes. It is not the true capacity of the pipette because the amount of water obtained by allowing the burette to empty itself at its normal rate from 0 to 45.23 is slightly less than the amount that would be gotten by drawing it out in nine portions with a considerable interval of time between each portion.

METHOD OF MARKING THE PIPETTE

The author of course hopes that no one will continue to put a mark on the lower stem of such calibrating pipettes, but there still remains the marking of the upper stem. This can be done as follows:

(1) A single mark arbitrarily placed is put around the upper stem. The exact capacity of the pipette from the stopcock to this mark is then determined by the method of Morse and Blalock. Such an instrument will measure successive portions of the same volume as they are drawn from the burette and the successive burette readings will correspond to the multiples of the capacity of the pipette. A variation of this plan consists in locating the mark on the upper stem so that it will correspond to some convenient whole number of cubic centimeters, such as 2 cc. or 5 cc. This is no advantage because, in any event, the burette readings will not fall on the marks of the burette representing such integral numbers or their multiples, and for plotting a correction curve the readings obtained by using an arbitrarily marked pipette would be of equal value with those obtained by the second method.

(2) A scale divided arbitrarily into small units approximating 0.01 cc. or so that each division corresponds exactly to 0.01 cc. may be combined with a major capacity mark which may be located in either of the ways described in (1) above. In using a pipette equipped with a scale, successive portions of the same nominal value, such as from 0 to 5 cc. on the burette, 5 to 10 cc. or whatever value the capacity of the pipette may be, are drawn out and their exact volume determined by measurement in the pipette.

"This appears to be an advantage, which is, however, more apparent than real, and will hardly pay for the extra labor required for the construction and location of such a scale unless a very large number of burettes are to be tested. In either case a correction curve can be made and the values corresponding to integral marks on the burette (1, 2, 3 cc., etc.) can be calculated upon the reasonable assumption that the bore of the burette does not change appreciably in a short length. Therefore, the error at any integral mark will be the same as at any reading in the immediate vicinity. Thus, if at 14.71 cc. the error is 0.05 cc., the same correction may be applied at 15 cc."

It might be interesting to compare the above method with the more laborious one employed in one of the previous articles on burette calibrating pipettes. The exact volume corresponding to the 50.00 cc. mark on a burette scale had been found to be 50.258 cc. and it was desired to find the volume corresponding to 49.52 cc. on the same scale. It was done by solving the proportion $50 : 50.258 :: 49.52 : x$, by which x is found to be 49.7755 cc. (The figures are given as they are found in the article in question.) If instead of making this calculation, it had been assumed that the error of the burette at 49.52 cc. was the same as at the near-by point, 50 cc.—namely, +0.258 cc.—the true value of the scale reading 49.52 could have been found by simply adding the correction 0.258. This gives 49.7780 cc. which differs from the other value, 49.7755 cc. so laboriously obtained, by only 0.0025 cc., an amount which under the circumstances could introduce no error.

In order to show the necessary details in manipulation and calculation there will now be given the complete procedure for determining the capacity of the calibrating pipette and for using the pipette in finding the errors of a burette.

DETERMINATION OF THE CAPACITY OF THE PIPETTE[1]

The pipette and a burette, connected as shown in the drawing, are filled with distilled water. Both instruments can be supported on one ring-stand by the use of two clamps. Air bubbles in the connecting parts can be avoided by having the enlargement at C full of water before the stopper is inserted. This causes an overflow through the hole, and if now the tip of the burette is also filled before it is put into the stopper, no air will be entrapped. The level of liquid in the burette is adjusted to zero and the pipette (which must be full) is allowed to empty itself through the tip at E. This point of filling and emptying before an actual measurement is made is necessary because the capacity of the pipette is affected by the amount of liquid on the interior. This amount must obviously be the same for the first pipetteful as for the subsequent ones. In the manipulation of the stopcocks it will be found convenient to leave the burette cock open and control the flow of water entirely with the two-way cock of the pipette.

[1] Before beginning an actual calibration, the rate of outflow of both the pipette and the burette should be adjusted once for all by properly constricting the outlet orifice. The stopcocks can then be opened to their full extent and the rate of flow will be correct without further regulation. Specifications from the Bureau of Standards require the outflow of a burette with a scale 50 cm. long—about that of a 50 cc. burette—to be not less than 90 seconds nor more than three minutes, and the free outflow time of a 5 cc. pipette to be not less than 15 seconds nor more than one minute. The most convenient way of adjusting the orifice to a given rate of delivery is to draw out the tip in a flame so that it is smaller than desired. One can then gradually enlarge it by filing or grinding across the end. By this procedure trial can be made from time to time without the necessity of waiting for hot glass to cool or for drying the wet glass before heating again, as would be the case if the usual method of allowing the tip to contract in a flame were employed. Finally, everything must be thoroughly cleaned with chromic-sulfuric acid mixture and rinsed with distilled water before beginning work.

With the level of water in the burette at zero and the pipette emptied, the next step is to allow water to flow from the burette into the pipette till the mark at B on the upper stem is reached. This portion is then allowed to flow out through the tip at E. In this way successive pipettefuls are drawn off and wasted through E till a point is reached on the burette beyond which another portion would bring the level of the water below the scale. This last burette reading must be carefully noted and, though it is the only one necessary for the calibration of the pipette, the intermediate ones should also be made and recorded because they may subsequently be used in determining the errors of the burette and because it is the simplest way of insuring the same conditions in the calibration as in the subsequent use of the pipette.

The next step is to find the volume corresponding to the last reading on the burette as obtained above. This is done by disconnecting the pipette, filling the burette with water, adjusting the meniscus to zero and then allowing the water to flow out at its normal rate into a tared flask till the point corresponding to the last pipetteful is reached. This portion of water is then weighed to the nearest milligram and from its weight and its temperature its true volume in cubic centimeters is calculated. The above experiments should of course be repeated several times till closely agreeing results are obtained, the averages of which are then used for the final calculations as follows:

Suppose that the capacity of the pipette is such that the tenth portion drawn from the burette by its use brings the level of liquid to 49.82 cc. on the burette scale and that the weighing of the water delivered directly from zero to this point gave its true volume as 49.88 cc. Since this volume corresponds to ten pipettefuls, it is evident that the capacity to be assigned to the pipette is 4.988 cc.

CALIBRATION OF A BURETTE

The calibration of a burette is carried out by connecting the pipette as described above and drawing off successive pipettefuls, noting the reading each time on the burette scale. Assuming a pipette with a capacity of 4.988 cc. and an average burette, readings would be obtained about as given in the first column of the table below. The second column gives the true

TABLE I

1 Burette readings	2 Correct volume	3 Corrections	4 Burette reading	5 Correct volume
5.05	4.99	—0.06	5.00	4.94
10.04	9.98	—0.06	10.00	9.94
15.04	14.96	—0.08	15.00	14.92
20.08	19.95	—0.13	20.00	19.87
25.06	24.94	—0.12	25.00	24.88
30.03	29.93	—0.10	30.00	29.90
35.06	34.92	—0.14	35.00	34.86
40.04	39.90	—0.14	40.00	39.86
45.05	44.89	—0.16	45.00	44.84
50+	Correction for 50.00 cc. is found by the method illustrated in Table II			

volume corresponding to the readings and is obtained by multiplying the capacity of the pipette by the serial number of the interval measured and rounding off the numbers to two decimals. Column 3 gives the corrections for the points in Column 1 and, since the corrections are the same for all points in the immediate vicinity of a given point, the numbers in Column 3 are also the corrections for the burette readings as given in Column 4. Column 5 gives the volumes corresponding to the "5 cc." points on the scale.

The above figures are from an actual burette and present a complication that may sometimes arise; namely, that when starting at zero the last pipetteful may bring the burette reading below the scale. This situation is, however, easily remedied by a simple trick of manipulation. Two or three sets of readings are wanted in any event in the interests of accuracy and when the first series shows that the last pipetteful brings the reading below the scale, the next series is started a little above the beginning of the second interval; in this case, for example, at 5.00 cc. on the burette scale. The burette readings are then as follows:

TABLE II

I Burette reading	II Correct volume	
5.00	4.94	The correct volume corresponding to the burette reading of 5.00 cc. is taken from Table I
9.99	9.93	
15.00	14.92	
20.03	19.90	
25.01	24.89	
29.98	29.88	
35.01	34.87	
40.00	39.86	
45.00	44.84	
49.98	49.83	

The true volumes corresponding to the readings are obtained by adding the appropriate multiple of the capacity of the pipette to the volume corresponding to the starting point which is taken from Table I and which must be checked by a separate experiment. This series of readings in Table II also gives the corrections for points in the immediate vicinity of those marks on the burette scale which are multiples of 5 and consequently may be applied at once to those marks. In other words, they are check readings on those of Table I, and in addition give the value of the correction for the 50 cc. mark.

If a correction curve is to be made, the above data are sufficient. In case it is desired to tabulate the corrections for each "cubic centimeter" mark on the scale of the burette the following procedure should be used: (1) The true volume of each 5 cc. interval of the burette is found by a series of subtractions based on the values in Table I, Column 5; (2) the value of 1 cc. in each interval is found by dividing the true volume of the interval by 5. Table III illustrates these two points.

TABLE III

Interval on burette scale	Volume of interval	Value of "1 cc." in interval
0 to 5	4.94	0.988
5 to 10 = (9.94 — 4.94) =	5.00	1.000
10 to 15 = (14.92 — 9.94) =	4.98	0.996
40 to 45 = (44.84 — 39.86) =	4.98	0.996
45 to 50 = (49.85 — 44.84) =	5.01	1.002

The final tabulation is made by adding these cubic centimeter values in Table III, the results being rounded off to two decimals. Table IV, below, covering part of the burette scale, shows this.

TABLE IV

Burette reading	True volume	Burette reading	True volume	Burette reading	True volume
1	0.99	8	7.94	44	43.84
2	1.98	9	8.94	45	44.84
3	2.96	10	9.94	46	45.84
4	3.95	11	10.94	47	46.84
5	4.94	12	11.93	48	47.85
6	5.94	..	.....	49	48.85
7	6.94	..	.....	50	49.85

If this plan is used, the tabulation should be made

on a stiff piece of paper or board so that it can be hung up near the burette.

CONCLUSION

In this article there has been described a modification of a burette-calibrating pipette that eliminates the mark on the lower stem and provides for the use of a two-way cock as an automatic zero-adjusting device.

A discussion of the principles underlying the calibration and use of such pipettes is also given.

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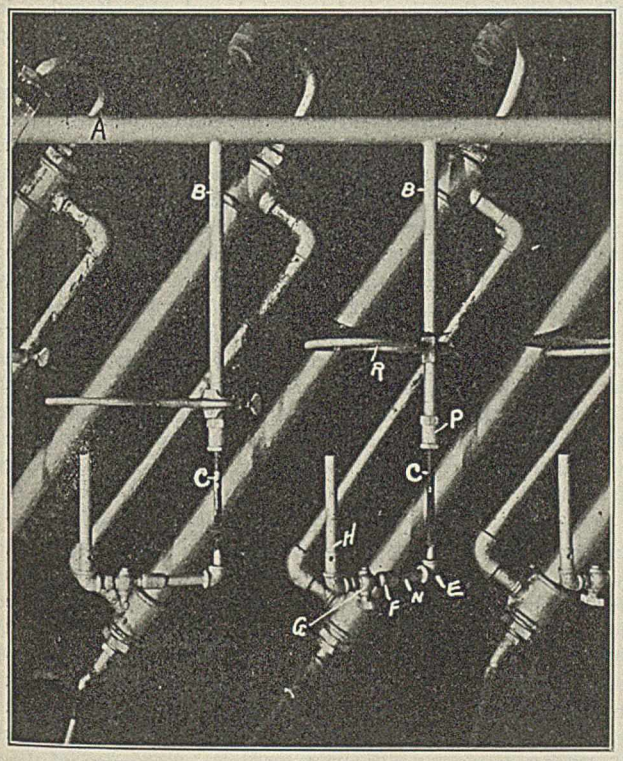
AN ADJUSTABLE BURNER SUPPORT FOR CONDENSATION APPARATUS

By H. E. BISHOP

Received April 19, 1915

The condensation apparatus described by H. E. Barnard and H. E. Bishop in the *Journal of the American Chemical Society*, **28** (1906), 999, was designed for use with flasks of uniform size only. The burner and flask supports were so arranged that in changing the adjustment of the still it was necessary to move them as a unit. To overcome this difficulty the burner and flask support to be described was designed.

The condensation tubes, water connection and their supports were not changed. The gas supply was changed from a position under the flask support to the top of the supports for the condensing tubes *A*.



The gas pipe was already tapped for $^1/_8$ in. air cocks to which the burners were attached. The air cocks were replaced by $^1/_8$ in. close nipples. An 11 in. length of $^9/_{16}$ in. (outside diam.) brass pipe, *B*, was tapped at one end to fit the $^1/_8$ in. close nipple and attached to the gas pipe. This pipe, hanging in a perpendicular position, forms the rod for the ring which supports the flask.

Into this tube was fitted a brass tube, *C*, which would slide easily. The lower end of this sliding tube was soldered into a $^1/_8$ in. brass elbow, *E*. A 2-in. $^1/_8$ in. nipple, *N*, was screwed into the other side of the elbow; then a $^1/_8$ in. coupling, *F*, which in turn took the air cock, was attached. Another elbow was attached to the air cock *G* which took the nipple for the tube of the Bunsen burner *H*.

The gas joint, which allows the burner to be adjusted up or down, is similar to the old gas drop-light which was on the market before the use of rubber tubing was so general. The lower end of the tube *B*, which forms the ring support and the outside member of the extension tube, was threaded to take an ordinary packing box, *P*, similar to those used at the top and bottom of the condensing tubes. Ordinary candle-wick packing, well oiled, was used. The addition of a ring, *R*, from the regular ring stand, completed the apparatus.

The great advantage of the apparatus is its wide range of adjustment for individual operations. Flasks from 5 in. to 14 in. high can be used simultaneously. The sliding gas tube overcomes the necessity for rubber connections and if more heat is desired, two burners may be turned under one ring. The cost of construction is small and the upkeep is *nil*.

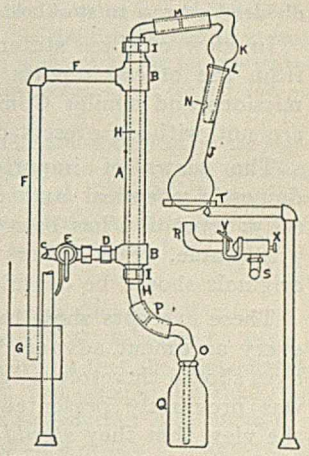
INDIANA STATE BOARD OF HEALTH
INDIANAPOLIS

A NEW AND IMPROVED FORM OF KJELDAHL DISTILLATION APPARATUS

By ARTHUR D. HOLMES

Received March 9, 1915

A description was given in THIS JOURNAL, **6** (1914), 1010, of a Kjeldahl apparatus which has given satisfactory service in this laboratory. This apparatus as described, when set up on a laboratory table of the usual height, has been found somewhat too high for convenience when used by a person of short stature. To avoid this difficulty, the apparatus may be modified as indicated in the accompanying sketch, which should be substituted for Fig. II of the original article. The height may be decreased 6 to 8 in. by replacing the upright type of burner with a horizontal offset burner, and shortening the condenser pipe accordingly. It is well to make sure, however, that the diameter of this pipe, and the rate of flow of the water in it, are sufficient to insure condensation in the tube *H*.



The modification not only lessens height, but also obviates the disagreeable results which often follow

the breaking of a Kjeldahl flask during the distillation. Whenever this occurs, the upright burner must usually be dismantled and cleaned, as it is generally coated inside and out with a crust of alkali, which clogs the gas passages. While the solution may in some instances run down the tube of the offset burner, at the worst it merely coats that portion of the burner and does not clog up any of the parts necessary for adjusting the flames; consequently there is less confusion and interruption of distillations.

Attention is directed to the fact that the pipe sizes given in the original article (refer to Fig. II) are outside measurements rather than the inside dimensions customarily used in plumbers' specifications.

LABORATORY OF NUTRITION INVESTIGATIONS
OFFICE OF EXPERIMENT STATIONS
U. S. DEPARTMENT OF AGRICULTURE, WASHINGTON

ADDRESSES

LEST WE FORGET! WHO KILLED COCK ROBIN? THE U. S. TARIFF-HISTORY OF COAL-TAR DYES

By BERNHARD C. HESSE

Received June 24, 1915

In 1914 the textile industry[1] said to the chemists of this country:

"The appeal of the textile industry to the chemist at present is: 'We need dyestuffs, so get busy and make them; don't hem and haw, and make excuses, but get right on the job.' "

Again in 1914 the dye-users[2] said to the chemists of this country:

"Users of dyestuffs in quantity are more or less indignant over the fact that manufacturers in this country are dependent upon other countries, and Germany particularly for the dye supply. They ask: 'Why haven't our chemical companies experimented sufficiently to produce synthetic dyes, pharmaceutical products, essential oils and synthetic perfumes, in the production of which Germany seems to have had almost a monopoly?'

"The users of dyestuffs say that the General Chemical Company, with its cash resources and its extra cash and stock dividends yearly, and other companies in a similar position, ought to have had sufficient initiative to use a portion of their large profits in experimental work, which would have permitted us to manufacture synthetic dyes without recourse to other countries and would not have permitted American manufacturers to suffer severely when imports were checked by the war. They state that the interests of manufacturers of the country should have been placed ahead of large immediate profits and unusual dividend returns to stockholders."

In view of these statements the following excerpts from the official reports of the various Tariff Commissions and similar Committees, from 1882 forward, are not without present-day utility and interest.

The views of importers, users, economists and domestic chemical and dye-makers are given quite fully; repetition has been avoided as far as reasonably practicable. For fuller information the complete originals should be consulted.

These excerpts show beyond doubt that practically every argument advanced in 1914 as to why coal-tar dyes should theretofore *have been* made in this country, was previously presented to Congress in support of the view that they *should be* made here.

These excerpts are here presented in the hope that careful study of them by the chemists of this country will pave the way for tariff treatment of coal-tar products, inclusive of dyes, on as nearly a fair and equitable economic basis as all the circumstances may require.

Report of the Tariff Commission, 1882

LONG BRANCH, N. J., July 26, 1882.

VOL. I—PP. 154–6. Mr. JOHN CAMPBELL, of New York City, a member of the firm of J. Levinstein, Campbell & Co., manufacturers of aniline dyes, appeared in response to the invitation of the Commission and made the following statement:

GENTLEMEN OF THE COMMISSION: We are importers and manufacturers of aniline dyes. We pay from 5 to 300 per cent duty on the different articles which we import. Our goods are used by paper makers, manufacturers of woolens and other textile materials, and in nearly every class of industrial pursuits. We are the third largest aniline-dye importers in this country, and pay annually duties amounting to nearly $100,000 upon the dyes we import. The duty now is 50 cents per pound, and 35 per cent ad valorem upon aniline dyes and colors, by whatever name known. With the exception of four small firms in the United States, who only manufacture two or three colors, out of two or three hundred imported, and who altogether do not employ more than fifty men, these dyes are all imported from Germany, England, France, and Switzerland.

As I have said, these colors enter into the consumption of nearly every manufacturer of textile fabrics, paper, leather, silk, ink, matches, soap, printers' and innumerable other trades. They cannot profitably be made in this country for various reasons: First, the raw material is here in only very limited quantities; second, the acids and other chemicals used for making these dyes are not made here; third, the skilled chemists who have grown up with this particular branch of industry are very few and are all engaged in Europe.

In every country in Europe, and even Canada, these goods are upon the free list. There is one dye, wool scarlet, a substitute for cochineal, which bears a duty of 135 per cent, while cochineal, the article it is a substitute for, is admitted free. This means a tax upon every 100 pounds of woolen or worsted yarn, dyed scarlet, of from $1.50 to $2, and to every manufacturer of hosiery (shirts and drawers knitted) 25 cents per dozen of shirts.

This compound duty of 50 cents and 35 per cent is a very unequal tax, as the bulk of the dyes are only worth abroad from 50 to 60 cents per pound, whereas at the time this duty was levied, scarlet dye was unknown, and the dyes then imported were worth from $2.50 to $10 per pound in Europe. I doubt if a single consumer of these dyes would advocate the retention of this portion of the tariff. I am in favor of the free importation of these goods, but still, if a duty be requisite for revenue, then I say make it ad valorem instead of specific and ad valorem, as the fifty cents per pound alone means upon some of these dyes 240 per cent duty, while upon others it means only 5 per cent.

I have no means of getting at the exact quantities imported into the United States, but from a list of the imports recorded in the *Oil, Paint and Drug Reporter*, which I take to be fairly

[1] THIS JOURNAL, 6 (1914), 945.
[2] *Wall Street Journal*, Dec. 28, 1914.

accurate, I find that from January 1, this year, to June 30, there were 532,000 pounds of aniline dyes imported into the city of New York, so that it would not be far from a correct estimate to place this year's imports into the United States at a total of 1,500,000 pounds, paying a duty of $1,500,000. If these goods are placed upon the free list it will go a long way towards enabling American home industries to compete successfully against foreign manufactures in foreign markets.

The three largest importers of these dyes are William Pickhardt & Kuttroff, of New York, agent for the Badische Aniline Company, of Stuttgart, Germany; Lutz & Movius, of New York, agents for Meister, Lucius & Brüning, Hoechst-on-Main, Germany; and ourselves. Our works are at Blackley, near Manchester, England.

These three firms import more than half of all the aniline dyes brought to the United States, while the remaining half are distributed between about twenty other firms.

Aniline dyes, although a manufactured article, are really and substantially, to the American consumer, a raw material. There has been, since the tariff was last framed, quite a revolution in this trade, which has brought them from the category of a luxury to a necessary and essential product, of great importance to the industries previously stated.

All the large carpet manufacturers use these goods, and the tariff is quite unequal. When it was first framed the duty was 30 to 40 per cent, but now the duty is 300 per cent very nearly on some of the articles.

By the PRESIDENT:

Question. Will you please state what the dyes you have referred to are made of, and whether they are manufactured in England any better than we could possibly manufacture them here?—*Answer.* Aniline dyes are manufactured from coal tar, or gas tar it is called in England. In England they are produced more extensively than here, for one reason that the material is not found in this country in such abundance as it is in England and for the several other reasons before mentioned. I understand that the coal found in this country does not contain so great a percentage of the light hydrocarbons as the coal found in England, therefore these dyes cannot be made here at such profit. In Germany and France they import their raw materials largely from England. Manchester is the center of production for aniline. There are four large firms engaged in the manufacture in Germany, two in France, and a few in Switzerland. The raw material at our command is not sufficient or cheap enough to enable us to make them at a profit at present, but if the duty is put up pretty high we will erect works and manufacture some of the dyes here ourselves. If the duty is taken off, this branch of industry will remain as it is at present.

Q. I would like to ask you as to the aniline dyes that are made in this country—whether their quality is good and whether you are limited to one color?—*A.* There are three colors made in this country. One is *magenta*, the raw material for which is imported from England. It is manufactured here and sold at a fair price, but the quality is not such as to enable it to compete with the imported article. The firm which manufactures it is located at Albany, N. Y. I do not think they employ more than about forty men altogether. There are three other concerns, employing a dozen men. That is the extent of the manufacture at present. They do not compete with the foreign goods at all.

Q. What amount of these goods are used by the different manufacturers of colored prints, for example; I mean of these aniline dyes?—*A.* I cannot tell you exactly the amount the different manufacturers consume, but the quantities imported last year were about 1,200,000 pounds, paying a duty of $1,200,000. These dyes take the place of almost every color. Cochineal has been generally used for dyeing woolen goods, but wool scarlet is used as a substitute for *cochineal*, which comes in free, while this has to pay 135 per cent duty. They replace also archil and other barks, woods, and extracts used for coloring purposes. This whole trade is yet in its infancy. The blue article that I introduced into this country enters into the manufacture of all the paper used by the New York dailies. It sold then at $4 a pound, and it took the place of *ultra marine*. All the paper-makers use it. Among the consumers of aniline dyes I might mention the following: All woolen manufacturers, who use it in the manufacture of bed-blankets, horse-blankets, carpets, shirts and drawers, flannels, hosiery, domestic woolen yarns, worsted piece goods, merinos, ladies' opera flannels, wool hats, overcoatings, &c. It is also used in the manufacture of dress goods, both woolen and cotton; ginghams, prints, and cotton yarns. It is also used in all classes of paper manufacture, not only for newspapers, but for paper used for wrapping purposes, for posters, envelopes, and wall paper; also in the manufacture of straw hats, willow and wicker work, leather for chair covers, and for printing inks, especially by all label press printers, and by matchmakers and jute-carpet manufacturers.

LONG BRANCH, N. J., July 26, 1882.

Mr. Joseph Wharton, of Philadelphia, representing the nickel interest, appeared before the Commission in response to its invitation and made the following statement:

VOL. I—P. 205. * * * * * *. I also know something about aniline dyes, because I was invited to go into that industry, and had occasion to examine it at the time. I declined to go into it because I had so many other kinds of business on hand. The idea that we have not in this country the material for manufacturing aniline dyes is absurd. A small fraction of the waste of our gas-works would make all that the country wants. There is a lack of skill here to produce the dyes, and a certain amount of danger to life in the process of producing them. They are mostly made by the use of arsenic, which makes poisonous compounds, sometimes destroying the lives of healthy workmen, and perhaps destroying the lives of the persons who use aniline-dyed carpets or live in the rooms where the walls are covered with paper colored with aniline. But there is no trouble about the making of aniline dyes in this country. I think it is an industry that should have every measure of encouragement that the government sees fit to give to other industries * * * *.

LONG BRANCH, N. J., July 26, 1882.

VOL. I—PP. 207–8. Mr. HENRY BOWER, of Philadelphia, made the following statement before the Commission in regard to the subject of aniline dyes, in addition to his former statement on the general subject of chemicals, given on the 22d of July:

I would like to make a short additional statement on the subject of aniline dyes. Sometime ago, while this whole question was being discussed in a public way, I received a letter from Mr. H. K. Lansing, the treasurer of the Albany Aniline and Chemical Works, relating to this subject, which I will take the liberty of reading. It was as follows:

ALBANY ANILINE CHEMICAL WORKS,
Albany, N. Y., February 8, 1882.

DEAR SIR: We desire to inform you that the manufacture of colors (aniline) commenced in this country, we think, in 1866 by T. and C. Holliday, who subsequently sold out to the Albany Aniline and Chemical Works, a company incorporated in April, 1868, with a capital of $25,000, and increased to $100,000. After expending all their capital on machinery and experiments in the manufacture of fine aniline colors, they reduced the capital to $25,000, and confined their attention to the production of aniline red until about two years ago, when new premises were purchased and some $60,000 expended for machinery. Chemists were brought from Switzerland and England, and we are now engaged in the manufacture of all the fine aniline blues, and

expecting ere long to make all the finer colors made in Europe. As an illustration of the benefit the country has derived from our efforts, we can state that large crystals of red were sold in 1868 at $6.50, gold. We now supply the trade with an acknowledged better color at $2.50 per pound. Blues were sold one year ago at $4. Since we commenced making the price has dropped to $2.50. We think we deserve the sympathy and encouragement of the powers that be.

Very respectfully yours,

H. K. LANSING, *Treasurer.*

I will state that I have notified Mr. Lansing of the hearing that is going on before you, and he will appear in person and make a statement on this subject.

I desire also to add that it appears that in 1880 there were 563,932 pounds of aniline dyes of foreign manufacture, of value, with duty added, $1,600,166.48, entered for consumption, while during the last census year only 80,518 pounds were produced in the United States, in value amounting to $107,282. These figures are the most exemplary that can be given to show the depressing effect on an industry of an unpremeditated reduction of duty. Had the other 50 cents per pound been allowed to remain, the position of aniline dyes would doubtless have been about the same as licorice and borax, and the country would have been independent in this regard. Not only has the reduction of this duty prevented the manufacture from growing until quite recently, but the danger of having another 50 cents per pound lopped off has naturally aided in hindering it, as one house sank $50,000, another $30,000 to my knowledge, following the reduction.

I am informed that the manufacture of aniline dyes in Europe is practically controlled by an English monopoly, which buys a large amount of material for this manufacture in this country, sending it to Germany and Switzerland, where these colors are produced by the poorest paid labor in Europe, and shipped to England and America. Already an extensive English house has made overtures to parties in this country, looking to the control of these products, and thus to deprive us of the raw material after present contracts have expired. I could name other articles of chemical manufacture which are held in about the same prospective condition if the large European combinations should succeed in breaking through the barriers of our protective system.

LONG BRANCH, N. J., July 26, 1882.

Mr. EVERETT P. WHEELER, of New York, representing the New York Free Trade Club, appeared before the Commission, in response to its invitation, and made the following statement:

VOL. I—P. 223 * * * *. I use in illustration of this the facts stated by Mr. Campbell in regard to aniline dyes. It was shown by him clearly, and I think there is no dispute about that, that the cheapening the cost of production of these goods abroad has not benefited to the extent it ought the parties in this country who use them, because the duty being a fixed one of so much a pound instead of being based on a sliding scale, the price has been kept up instead of being diminished. And, as a consequence, all of us who use printed goods of any description, or paper of any description, have to pay more in the long run than we otherwise should have done if the manufacturers could have bought a cheaper dyestuff.

P. 229 * * * * *. Why should not, then, the third class of wools, the heavy wools, be put on the free list? That certainly would be a great benefit to the carpet manufacturers of America; and if this other suggestion made by Mr. Campbell to you should be carried out, and these aniline dyes should be put on the free list as well, the production of American carpets would be cheapened to such a degree that they could compete with great success in the South American market and in other markets. The goods we make are good in quality; a great deal of money is expended in designs for them, and I think any one who has examined the American carpets of recent make has been astonished at the amount of taste shown in the designs * * * *.

P. 230. Let me make just one suggestion on the question of dyestuffs. I want to call attention to the census bulletin in regard to the manufacture of chemicals. You will observe in regard to these dyestuffs that they have almost entirely displaced the vegetable dyes. The duty in many cases amounts to more than 100 per cent *ad valorem*. Even if it were possible for us in this country to prohibit for the next ten years the importation of these colors, would it be a wise policy for us to do it, considering the extent to which you have been shown they enter into all manufactured goods? Would it be a wise policy for us to build up a manufactory of aniline dyes in this country when they can be made more cheaply abroad because the raw material is found in a cheaper condition in England? The English coal, as everybody knows, is richer in the hydrocarbons or inflammable matter than our American coal, and it is well known that we do import to some extent English coal to make gas, although the duty on it is a high one. The only objection that has been or could be made in regard to that would be that if we got into a war with some of the European countries we should be at a disadvantage in regard to these colors. I suggest that that is a very contingent and remote disadvantage; that the probabilities of such a war are insignificant. These goods are made not only in England, but in Germany, and if the worst came to the worst, and we were cut off from our European supplies, we could fall back on the vegetable dyes that came from South and Central America before aniline dyes were invented * * * *.

PP. 236–237. In regard to one suggestion which was made, which goes to the whole root of the matter, that it was the object of the government to lay a tax to enable people to do a business which would be profitable, which otherwise would not be profitable, I will say this: Where that applies to large amounts of money invested, that is one thing; but where it applies to a creating of a new business that is not necessary and that the country can do without, we should pause before committing ourselves to that proposition. If there were an embargo, and we could not import anything, I suppose all sorts of industries would spring up here at once. In regard to the aniline dyes, it was said to be a poisonous business, and the people engaged in it suffered very much on account of the poisonous materials used. If that is so, why should we desire to build up a business of that kind? The gentlemen from Albany, Mr. Hendrick, spoke of a 35 per cent ad valorem duty. Certainly, in the present condition of that business, considering the existing rate, I should not contest that proposition, so far as the aniline reds are concerned; I should not oppose, but consider it just to put the duty at that figure. But I should object to keeping all aniline dyes at the rate of 35 per cent so that Mr. Hendrick might be enabled to build up a new business for the purpose of increasing the cost of all articles that are made with those dyes.

LONG BRANCH, N. J., July 27, 1882.

VOL. I—PP. 253–256. Mr. James Hendrick, president of the Albany Aniline and Chemical Works, Albany, N. Y., appeared before the Commission, upon its invitation, and made the following statement:

The history of our business is simply this. In 1866 my attention was called to the manufacture of aniline dyes, and I considered it a legitimate manufacture in this country which ought to be developed. Some gentlemen associated themselves together and we purchased the establishment of T. and C. Holliday, the only establishment of that kind then in this country, and began the manufacture in Albany of this article, putting in at first about $25,000 and subsequently increasing the amount to $100,000. We lost that amount of money and $50,000 additional in the business. In 1872 I took personal

charge of the manufacture, and, applying to it practical business principles, found it could be made a success in certain directions. I emasculated everything from the manufacture except the article of "aniline red." We continued the manufacture of aniline red for seven or eight years and made an article, acknowledged by all manufacturers in this country as well as those who know of it in Europe, to be equal to anything made abroad. The price of it at that time was $6.50 in gold. We are selling it now at $2.25, and are supplying the manufacturers of New England, and today they are giving us orders for more than we can make of it. As I presume you are all aware, all these aniline colors are made from an oil procured from coal tar—the benzole made from coal tar. We have been obliged to import that because of the difficulty of getting it in this country in large enough quantities to distil it. We have been importing all of this oil that we required, but now we are manufacturing it a little. I have in my pocket a sample of aniline oil manufactured from benzole, which is, in turn, manufactured from the residuum of petroleum. I have also a sample of cloth dyed with the various colors that we make ourselves. These dyes we make in our factory, but not in large quantities. We are putting up machinery now which will enable us to manufacture on a larger scale.

The Pacific Mills and other like manufactories in this country express the strongest hope that we shall receive from you the encouragement we are entitled to. In a letter addressed to me within a week by Mr. Saltonstall, the treasurer, he said there were some importers, or the agents of foreign color companies going through the mills in New England, expecting to get a petition signed in favor of the reduction of the duty on aniline colors, and he said they would have no sympathy from them and cautioned me against them. I have no doubt you will have an application to this effect. I have not come here to tell you what you shall do. I can only point you to the evidence we have of what we have done in our little way toward reducing the price from $6.50 to $2.25, and we propose continuing that warfare. We have not made a large amount of money, and every dollar we have made, we have spent in improving the manufacture of these colors, so that the investments we have made from the year 1866 up to the present time, have not yielded us $1^1/_2$ per cent on our money. But we are developing the business we have helped to create and the country is getting a benefit. I will leave you samples of these colors I have referred to.

By Commissioner AMBLER:

Question. As I understand the matter, this is the product you obtain from the residuum of petroleum, and you are still continuing your experiments endeavoring to extend the number of colors to be made?—*Answer.* Yes, sir.

Q. I do not understand that you now make a multitude of colors, so as to be able to put them on the market?—*A.* Not all of them. We are manufacturing the colors I have exhibited.

Q. From these experiments which you have made you think you can make a variety of colors, and are putting in the machinery now for that purpose?—*A.* Yes, sir.

Q. It has been suggested here that the raw material for making these colors is not obtainable in the United States. Is that the fact, and, if so, what is the cause of it?—*A.* It is a fact, for this reason: That, as I endeavored to explain, the gas-tar was not gathered in sufficient quantities in this country to make the benzole, and the expense of distilling benzole into aniline oil has been too large for any party to engage in it. But there are two parties now making benzole, the New York Coal-Tar Company and one other, and they are exporting benzole, and we are importing the oil. If we get the oil industry started, as we expect to do, we shall not be dependent on foreigners for our oil, but they will be dependent on us.

Q. Have you taken any steps towards producing this aniline oil?—*A.* Yes, sir; contracts are out for $35,000 worth of apparatus with which to manufacture it, and I have a chemist here from France to superintend the work.

Q. How long have you been making these other colors? I do not mean the aniline red.—*A.* Not more than about two years.

Q. Are there any other firms in the United States engaged in the manufacture of these aniline colors?—*A.* There are three or four, I think. There is the firm of T. & C. Holliday, in Williamsburg, N. Y., another one in West Virginia, and one in Buffalo, N. Y. Those are the only three I know of; I have heard of others.

Q. Up to this time, as I understand you, this has been an unprofitable experiment?—*A.* I cannot say that; but we have been spending a large amount of money.

Q. Have you been able to make aniline red at a profit?—*A.* Yes, sir; we have been making it at a profit, but all the profit we have reinvested. We have upwards of $250,000 invested in the business in buildings and machinery, and this will be the result of the profits for the last ten or twelve years.

By Commissioner KENNER:

Q. Are these colors fast colors?—*A.* They are as fast as colors can be made. All aniline colors are a little fugitive; that is to say, the sun will fade them somewhat. All the red garments you wear are made from them, every one of them. We have everything in this country that is necessary to manufacture aniline dyes. We have brains enough to do it; and I think we are as able to make them as any foreigner is.

By Commissioner AMBLER:

Q. I am requested to inquire of you (and your answer can be given now, or hereafter, in writing) what you would regard as a sufficient duty for the protection of your manufacture?—*A.* My individual opinion would perhaps be of no more value than the opinion of any other person. We do not want to make a great fortune by large protection. I think, perhaps, that a fixed duty of $1 per pound would be preferable to the duty of 50 cents per pound and 35 per cent ad valorem.

Q. Would not that operate very unequally in this respect, that some of these colors are very much more expensive to produce than others?—*A.* Yes, sir.

Q. Have you any remedy to propose as to that; that is, can you suggest any mode of making the rates equal?—*A.* No, sir; if I were to suggest a plan I should say let well enough alone; let the business go along until it is better developed, and it will regulate itself by and by. I believe the great curse of the country today is change in these laws; and I think the less we change the tariff, as it affects commercial and manufacturing interests, the better. It is a trite saying, attributed to President Lincoln, that you should never swap your horses when crossing a stream. I think that principle should apply in this case, and that when we are trying to develop a business it is not well to change the laws affecting it too often.

Q. It is complained that this is an unequal duty. The only purpose I had in asking the question was to ascertain whether you had anything to suggest which would make it an equal duty; and I now ask you specifically, would an ad valorem duty, at a proper percentage, be a fair duty?—*A.* It would if you could get at the ad valorem; that is the great difficulty. The manufacturers on the other side of the water are exceedingly smart, and they will tamper with colors, and represent one color to be a different color; and the difficulty is in getting competent men who know the value of an article, and will place the true ad valorem on it. I have heard of expensive colors being introduced under a new name in order to get rid of the duty. Therefore, I say the other way is the more equitable method.

By Commissioner GARLAND:

Q. I understood you to say, in regard to the supply of the

raw material, that you were importing it from abroad?—*A*. We have imported all the raw material of which we make these colors, and are doing so today.

Q. Is there not enough material in this country, if it was collected properly, to furnish the supply, or what is the difficulty?—*A*. The difficulty has been that it was not profitable to go into that branch of the business. The tar yields $^3/_4$ to 1 per cent of benzole, both the American and the English tar.

Q. Is the English tar better adapted to the purpose?—*A*. It is one-eighth of 1 per cent richer, that is all. But we think the American tar would be quite as good, the only difficulty is in getting it together and carrying it from one place to another, which would add the cost of transportation.

Q. Then I understand there is enough of that material in this country, but the difficulty is in getting it together?—*A*. Yes, sir. Even if this product of petroleum fails, which I think it will not do, there would be an abundance for our own use and that of Europe besides; I mean of the benzole extracted from tar.

By Commissioner McMahon:

Q. If it should be decided to apply an exclusively ad valorem duty, what rate would you recommend?—*A*. I think about 35 per cent would be fair; that is my impression about it. I should make as few changes as I could.

By Commissioner Underwood:

Q. Would it be possible for you to furnish the Commission with a schedule of duties on these different articles which would enable the government to collect duties without ambiguity and the commission of fraud?—*A*. Not unless you can make men perfectly honest. If we had honest men everywhere, there would be no trouble. There would be no difficulty in enforcing such a schedule in case men did not resort to dishonest practices. In that case I think 35 per cent would be about a fair rate. I think we could live if it were fixed at that figure.

By Commissioner Boteler:

Q. You think specific duties are better for the government and for the parties concerned?—*A*. Yes, sir. Specific duties I believe in, because they are easily collectible, and men have no disposition to be dishonest; but with ad valorem duties the temptation to fraud is greater. That is my view of that matter. I will leave you these samples that I have referred to in my statement, and, if you desire, I will give you any further information I possess, from our books or in any other way.

Long Branch, N. J., August 21, 1882.

vol. 1—pp. 565–568. The following communication, regarding duties on aniline dyes and coal-tar products, was received from Mr. V. G. Bloede, representing the American Aniline Works of Parkersburg, W. Va.:

Gentlemen: Having found it impossible, during my recent hurried visit to New York, to accept your invitation to appear in person before your committee, I adopt this method of communicating my views upon some of the matters you now have under consideration.

The firm of Bloede & Rathbone, of which I am a member, is engaged at this point in the manufacture of various chemicals, chiefly such as are used in the dyeing and printing of yarns and textile fabrics. Our firm is also largely interested in the business known as the American Aniline Works, and it is particularly in this line of manufacture that I feel competent to communicate important information to your committee. The production of aniline colors from our native crude materials is a business, the benefits of which seem to me to belong most legitimately to this country, and forms a fitter subject for heavy, even prohibitory, duty than many other branches of trade depending exclusively upon imported crude material. Strange to say, although we have all of the chief crude materials in this country, it is only within the last two or three years that the production of colors exclusively from our native products has been attempted. Prior to this time a few small works had been engaged in the manufacture of a few simple coal-tar dyes, but they worked exclusively with a crude material, combined and manipulated by European skill and imported into this country, duty-free, in a half finished condition, *i. e.*, in the form of arseniate of aniline. To produce this material, American benzoles and other coal-tar products are shipped abroad in a crude state at a heavy expense, manipulated by foreign skill and labor at another heavy expense, and returned to us still as a crude product, but largely enhanced in value. The entire profits of manipulating our own crude material have thus for years been lost to our country. I believe I am correct in stating that the American Aniline Works, which I have the pleasure of representing, was the first concern in the United States which succeeded in producing on a large scale the base used in the manufacture of these colors, *i. e.*, aniline oil, from the crude coal-tar products of our own country, and exclusively by home labor. It is not necessary for me to dwell upon the almost insurmountable difficulties encountered in a new manufacture of this kind in a country totally devoid of skilled labor and experience. It generally means one of three things: first and generally, a total failure; second, the importation of skilled labor from the other side (a class of labor which seldom flourishes under the business conditions here existing), or, as the American Aniline Works have done, the *redevelopment*, as it were, of the entire process of manufacture by a long series of difficult and costly experiments. One thing that is retarding the utilization of our home products more than anything else is the fact that, by the grossly unjust and arbitrary provisions of some sections of our tariff, aniline oil, and the half finished product known as arseniate of aniline, have been hitherto admitted free of duty, a provision wholly and exclusively to the benefit of the foreign producers. The natural result has been that no American manufacturer could be found willing to devote his time and capital to the development of a branch of industry in which Europe has the advantage of twenty-five years' experience. To insure the utilization of our own coal-tar products under the best possible conditions for success, I would most urgently request that your Commission recommend a duty to be placed upon the two crude materials named, as well as any others that can be produced here, so as to insure to our country the benefits derived from the consumption of our own coal-tar products. In my opinion, had our tariff not been defective in this vital particular, and aniline oil and its compounds had early paid duty, the manufacture of the articles from our own crude coal-tar products would have been an assured fact years ago. I believe that our people are fully competent, not only to hold their own against the competition of other nations in any manufacture, but that they are their superiors in many essential particulars. At the same time it is absolutely necessary that a new enterprise of this kind, in order to compete successfully against the products of a quarter of a century of European research and experience, be liberally protected until our own manufacturers have acquired sufficient knowledge and experience to enable them to hold their own against these odds. I would therefore urge that aniline oil, arseniate of aniline, and other salts of the base be protected with a specific duty of from five to ten cents per pound. I would also urge that the duty on the intermediate products, such as nitrobenzole, and binitrobenzole, and its homologues, be maintained. The duty on nitrobenzole is now two cents per pound, while binitrobenzole, which is merely nitrobenzole combined with more acid, pays a duty of 20 per cent. I would recommend that the duty upon all nitro compounds of benzole and its homologues be made a uniform one of 10 cents per pound, as in the case of nitrobenzole.

I have carefully examined some of the statements made before your Commission, and must say that some of those presented on behalf of the foreign manufacturers are certainly extraordinary misstatements of facts. Mr. John Campbell, for instance, appeared before your Commission, and, unless the press misrepresented him, made the remarkable and wholly erroneous statement that a color costing $1 per pound in England would, under the present duties, cost $4 per pound laid down on this side. This is such a very gross misstatement of the facts that I hesitate to believe it was seriously offered to your Commission. Such a color as Mr. Campbell speaks of, after payment of all duties, freights, and the like, would cost less than one-half that sum, say $1.90 per pound. The result of home competition is already so strongly felt in some lines, for instance fuchsine and other reds, as almost to have stopped all importation, and it is my opinion that within a short space of time these colors can be made as cheaply in the United States as in any country of Europe. This is the direct result of protection and the stimulation of home enterprise, and there is no reason whatever why, within ten years, or even a much shorter period, if we are only able to avail ourselves, by means of a liberal protection, of our domestic wealth in crude material, all other coal-tar colors should not be in the same position.

Whatever course your committee may take as regards the older chemical industries of this country, I would urge that the aniline branch be liberally protected at least for a few years. As before stated, it is an industry so new that up to two years ago not one pound of the base used in the manufacture of these colors was made in the United States.

A great deal has been said, and with much force, upon the nature of the duties imposed on aniline dyes, and the injustice resulting therefrom. A duty like the present one, of 50 cents per pound and 35 per cent ad valorem, I believe to be wholly wrong. It annually deprives our government of thousands of dollars of legitimate revenue, and entails an enormous and unnecessary expense in collection. Many of the manufacturers on the other side have resident partners here, and it is the general impression that an enormous amount of color finds its way into this country under the ad valorem system at a very great undervaluation. That this system of collecting duties at least opens the way to a great deal of fraud will be seen at a glance by your Commission, when I state that the various aniline blues, for instance, range in price from $2 to $15 and $20 per pound. The difference is not one of strength, but only of purity and quality of shade, some high-priced colors being actually weaker in point of strength than others of a low price. These colors are sold under arbitrary names and marks, such as B, BB, &c., up to 5 B or 6 B. Now, suppose an unprincipled person wishes to undersell his competitor, all that he has to do is to mark his 5 B, or 6 B, or other mark, worth, say, $12 per pound, down to B or BB, worth, say, $3; the result is the evasion on his part of 35 per cent duty on $9 of each pound of this color, or the enormous sum of $3.15 on every pound. It is utterly impossible for the largest corps of experts the government can command so to test the samples as to make such frauds impossible. The interests of the government, the consumer, and the honest dealer, require a change of this system to one of *specific* duty, or so much per pound of color. The average value of the aniline dyes imported into this country we will say is $6 per pound. Under the present system, such a color would pay a duty of $2.60 per pound, and I would recommend that a uniform duty of from $1.50 to $2 per pound be imposed upon all aniline dyes of whatsoever name or quality. While it is true that such duty would be prohibitory as regards the cheaper grades, the answer to this is, that such dyes can and are already produced in this country at a price to exclude, or almost exclude importation, even under the present system of duty. By adopting a specific duty a large expense would be saved the government in the collection of the duties, a larger revenue would result, the consumer would be largely benefited by the higher grade of the colors, and honesty on the part of the importer would be insured, as it would necessarily break up the system of undervaluation, or cost invoicing, adopted by many of the European manufacturers having resident partners on this side. Should an ad valorem duty be continued, I would urge your committee to move a Congressional investigation having for its object the breaking up of the system now in vogue for the evasion of duty.

Some efforts have been made to show that the present rate of duty on these dyes is very onerous to the consumer and the public; such is not the case, however, for two reasons: first, because the branches of business consuming them are themselves protected by almost prohibitory duties, and lastly and chiefly, because the quantity of dye used per pound of cloth or yarn is almost infinitesimal. Taking the case of fuchsine, for instance, a color costing only $2 per pound, but four or five ounces are required for every 100 pounds of carpet-chain; this means a tax through present duties of only 3 or 4 cents on an average size rag carpet. The fact is that while a removal of the duties would deprive the government of a large revenue, and kill the home industry outright, no one class, except the foreign manufacturer, would be benefited. This was shown a few years ago in the case of artificial alizarine. By the assistance of the consumers the duty was removed from this article, ever since which time the said consumers have to pay about as much again for the article as their foreign competitors, and the large revenue that would have resulted to our people by a duty was absorbed by the foreign manufacturers and their agents. It is therefore desirable that neither the government nor the consumer be again inveigled into such action on behalf of a wholly foreign industry.

Before closing I would call the attention of your committee to the fact that, owing to the vitality the American aniline manufacture is beginning to show in the last year or two, the foreign manufacturers of these dyes have combined for a concerted action, and are making extraordinary efforts looking to the repeal of the duties and the killing of this promising industry Among other devices adopted, is the one of obtaining signatures to petitions among the consumers of these dyes, asking for a repeal of the duties. These petitions have been gotten up by the New York representatives of a large foreign corporation, and are being extensively circulated for signatures. I state this so that when such petitions are presented, it will be understood that they are not the sentiments of the American consumers of these dyes, who, as far as my knowledge enables me to speak, are *universally* in favor of and willing to pay their quota towards the successful introduction of this manufacture in the United States. The actual disposition of the largest consumers of the anilines is fairly represented by the following sentence in a letter recently received by me from one of these consumers: "The representatives of a large European aniline works are making a great push to have the duties on anilines reduced. I inclose you their circular which they are sending to all the manufacturers to obtain signatures. What do you as a manufacturer think of it, and what would you propose? We can stand it as it is, and, having all the protection we need on our manufactures, are willing to give all that is required to others."

I have the honor of remaining, very truly yours,

V. G. BLOEDE.

PARKERSBURG, W. Va., Aug. 10, 1882.

BOSTON, MASS., August 24, 1882.

VOL. I—PP. 661–663. Mr. HENRY A. GOULD, of Boston, refiner of camphor and manufacturer of aniline dyes, addressed the Commission as follows: * * * *

I hope that the Commission will be able to recommend a reduction of the duty upon aniline colors. The duty now, as

you well know, is 50 cents a pound, specific duty, and 35 cents a pound ad valorem. I represent a house in Germany, with a capital of $10,000,000 or $12,000,000, and we sell the goods in the original package in this country. I have reason to know that the duty is so high that it leads, in the first place, to corruption and misrepresentation of goods brought into this country. Without desiring to make any definite statement, I may say that I feel that goods are, owing to this high duty, often brought in on a wrong valuation in many respects. The argument on this question has been gone over before you very fully by Mr. Campbell, but I may say, in brief, that a duty of 20 or 25 per cent would answer all the purpose of protection, as I have instanced in regard to the matter of camphor, and would help the manufacturer, without being a burden on the manufacturer of textile articles. I paid a visit to South America last summer, and while there could see the reason why they imported their goods from England rather than from this country. The 3 or 4 per cent which is added on to the cost of American goods by reason of this heavy duty on the raw materials used in their manufacture is the cause of it. Our house in South America imports hundreds of packages of goods from Manchester and other sections of England that we should import from this country if the prices were lower. Of course, every tax of this kind that is added to the original cost of the goods acts as a prohibition upon trade from this country. We have a house in South America for which we import largely from England. The freights on goods exported from this country to South America are much larger than they are on goods exported from England, and, of course, the percentage of cost for these pigments and colors add very largely to the cost of the print or the manufactured article. I think a moderate duty would do away with the tendency to undervalue these colors when they are imported. At the present rate of duty it is certainly a very great temptation to fraud.

By the PRESIDENT:

Q. How much does the duty on aniline colors affect the price of the ordinary American prints, for instance?—*A.* I am not prepared to answer that question exactly; but I know that we have very carefully prepared tables showing the cost of prints imported from Manchester and the cost of prints and other colored goods made in this country, and the difference is considerable; and, of course, as you can see, every additional tax on the manufacturer adds to the cost of the manufactured article. A duty of 25 per cent would answer all the purposes of protecting the American manufacture of aniline colors, as I have instanced in the case of camphor, without adding as heavy a tax to the user of aniline colors. As Mr. Campbell has said, there are from one to two million pounds of colors, representing millions of dollars in value, imported annually into the country, but yet the business is in its infancy. I imported in 1866 the first aniline colors ever brought into this country.

Q. What colors were they?—*A.* They were blues and reds. I had very hard work to dispose of my first consignment of 1,000 pounds; it took me nearly six months to do it. But in the next six months I sold from $50,000 to $75,000 worth, and the business has increased very rapidly ever since. I am satisfied we cannot manufacture these dyes in this country as well as they can abroad, unless there is a change in the prices of labor and in other particulars. In Germany laborers are paid from 60 cents to $1.12 a day, while the same laborers in this country receive from $1.50 to $2.50 a day. Alcohol is very cheap in Germany, while here it is loaded down with taxes. Nitric acid there is cheap, while here it commands a very high price per ton. And so I might go through the whole catalogue and name the elements that enter into the production of these colors. I should be very glad to see them made in this country, and even as an importer would readily submit to a fair rate of protection in order to develop that industry. There are only three or four companies in this country manufacturing these colors, and with every advantage of protection they have kept the price up as high as the tariff would allow them to, and made the manufacturers pay a royal price for their colors, and the textile manufacture has not been benefitted by it, and they never have been able to make one or two of the last colors. My house, in Germany, manufactures some two hundred colors, while such concerns as the one in Albany, the one at Buffalo, and one or two in Philadelphia manufacture only one or two colors. There are a dozen companies in Europe having a capital of from $12,000,000 to $15,000,000, some of them; even the smallest of them have at least a million dollars capital, and in that way they can manufacture to very great advantage. I am speaking now of aniline colors, without referring to alizarine, for that is a monopoly under a patent.

Q. Is the price of alizarine due to the high tariff?—*A.* No, sir; it is a free article; it is due to the control by one house of the patent under which it is made; it is a monopoly. We represent a manufacturing house in Austria which makes it, but we are prohibited selling it in this country, under a decision given by Judge Lowell. The decision is regarded in Europe as unsound, but nevertheless we have to abide by it.

Q. How much lower are the European users able to buy this alizarine than American users?—*A.* I could not answer that question, because since we were enjoined from selling the article I have not followed the price of it. I only know that after the decision of Judge Lowell the manufacturers here raised their price over 100 per cent in a very few months.

The PRESIDENT. I wanted to bring out the fact that the high price of alizarine, one of the most important of the aniline colors, is not due to the tariff.

The WITNESS. A specific duty in one sense would be an unjust one because of the fact that the colors are valued at different prices. A low ad valorem duty of 20 or 25 per cent, it seems to me, would answer every purpose and protect the American manufacturer. As it is now the profits all go into the pockets of these few manufacturers. A reduction of the duty would reduce the price to the consumer, and enable him to procure the better article which is made abroad. I suppose there are some things that we cannot make in this country, which we shall have to let other people in other countries make for us.

BUFFALO, N. Y., August 30, 1882.

VOL. I—PP. 749–750. Mr. J. F. Schoellkopf, Jr., of Buffalo, manufacturer of aniline dyes, addresses the Commission as follows:

GENTLEMEN: In addition to my communication of July 27, 1882, I desire to call your attention to the following circumstances: Coal tar is procured from bituminous coal; benzole, the raw material for aniline oil, is gained from coal tar by distillation. Now, benzole pays a duty of 40 cents per gallon, whereas aniline oil comes in free. These facts certainly must have been misrepresented at the time the present tariff was framed, for it is evident that if the raw material, benzole, is protected, the manufactured article, aniline oil, is justly entitled to the same privilege. Aniline oil, which is used directly for printing black (on cotton), cannot be manufactured as cheaply here as in Europe, owing to higher labor and high prices for acids (sulfuric and nitric acids) used in its manufacture.

I have learned that New York and Boston parties are circulating a petition among the larger consumers of aniline dyes, with the intention of reducing the duty on such dyes to 25 per cent ad valorem only. This would leave domestic manufacturers virtually without protection. We must have an *absolute* protection, and this can be realized only by a specific duty. I would suggest the raising of the specific duty 25 or 50 cents per pound and dropping the ad valorem duty altogether. This

would enable home manufacturers to compete with foreign producers.

By Commissioner AMBLER:

Question. Would not that operate inequitably by reason of the fact that there is a great difference in these dyes? Some of them, I understand, are cheap and others are expensive.—*Answer.* Yes, sir.

Q. How do they range in price?—*A.* From $1 to $5 per pound; the principal colors.

Q. I would suggest that a specific duty per pound, to afford any protection at all on the $5 article, would be too much on the cheaper article.—*A.* But, as I mentioned in my former communication, if we have protection, the domestic competition will reduce the price to a proper level. There are only five manufacturers of aniline dyes in the United States at the present time.

Q. Is it not a fact that any rate that operated as a protection on the $5 article would amount to a prohibition on the article that costs $1?—*A.* It does not seem so, for they are still importing fuchsine, which is a color worth from $2 to $2.50 a pound.

Q. Did you mention any specific amount of duty per pound which you think would be proper?—*A.* Yes, sir; the rate of duty now is 50 cents a pound, and 35 per cent ad valorem, and I suggest dropping the ad valorem rate and raising the specific rate 25 or 50 cents per pound.

Q. You mean, raise it 25 or 50 cents above the present duty of 50 cents?—*A.* Yes, sir.

Q. That would amount to a duty of 100 per cent on $1 dyes, and a duty of 20 per cent on $5 dyes?—*A.* Yes, sir; but, as I mentioned in my former communication, under these ad valorem duties imported dyes are liable to be undervalued.

Q. Are they generally undervalued?—*A.* I do not know, but I think they are, because it cannot very well be detected. I suggest this high duty in order to give the home manufacturers a start. After five or ten years it would not matter if the duty were taken off; but we must have a large protection to enable us to start. When I was in Europe this spring I was told that if the duty was not taken off in this country the manufacturers there would start establishments in this country, so that we would have plenty of competition.

By the PRESIDENT:

Q. Will you please repeat that statement; do you say that the foreign manufacturers themselves would begin the manufacture in this country?—*A.* Yes, sir. The president of the largest manufactory in Europe, the Badische Aniline Factory, at Mannheim, told me personally that if the duty was not taken off they would be obliged to start factories over here. I think that shows that the price today in this country is as cheap as it can be.

Q. How many dyes does that establishment now make?—*A.* They make almost all the known colors. Dyes can be made here, in time, as cheaply as in Europe; but we must have a chance to start the business.

NEW YORK, October 7, 1882.

VOL. I—PP. 1960–1962. The following communication from Mr. A. KLIPSTEIN, of New York, in regard to the duties on dyestuffs and chemicals, was ordered to be printed:

I would recommend putting upon the free list every dyestuff and chemical used in dyeing, calico printing, &c., and every chemical used in making paper, soap, and glass, in bleaching and other industries. These articles may be fairly classed as raw materials for the use of these industries. If these various industries could get their dyestuffs and chemicals free, the saving to them would be so considerable that they would be upon a much better footing for competing with the foreign manufacturers, and it would lead to a large increase of the export trade in their products * * * * *.

Aniline dyes and colors should be made free. They pay now the enormous duty of 35 per cent ad valorem and 50 cents per pound. At the time the tariff was framed these colors were comparatively little known, and their importance not recognized. Their price was at that time very high, and the 50 cents per pound specific duty was not felt so much. Since then great progress has been made in the manufacture of these dyes, the prices have been very considerably reduced, and large quantities are used.

The difference in duty which our print works, woolen mills, dyers, &c., have to pay is in many instances very considerable, many mills using large quantities, and the saving would amount to each of them to many thousand dollars per year.

The duty on the lower-priced colors, in consequence of the 50 cents per pound specific duty, amounts to 130 per cent. Notwithstanding this enormous duty, there is only a very small quantity (comparatively) of aniline colors made in this country, and the industry has made no progress here in twenty years. This is owing to many circumstances.

What is made at Albany, N. Y., and at some other small factories in the United States, is only the first stage, *viz.*, fuchsine (red). The higher class of colors are not produced, and it is not likely that they will be made of good enough quality.

It is not just that large industries (like the cotton, woolen, silk, calico printing, &c.) should be taxed heavily to support these small factories.

Other dyestuffs and chemicals are used in dyeing, calico printing, &c.—some of these are already on the free list, while others are taxed for no apparent reason. It does not appear, for instance, reasonable that such articles as archil and extract of archil, cudbear or extract of cudbear should be free of duty while the following articles are taxed; for if a high enough duty was imposed on the above, no doubt they would also be made here * * * * * * *.

Through these tariff restrictions our manufacturers of textiles, &c., are prevented from using to advantage many articles like carmines, lakes, and other special preparations for calico printing, &c., which their competitors in Europe can employ.

Madder lake is taxed 25 per cent, but on the other hand extract of madder is free; naphthalene yellow and naphthalene brown pay 35 per cent and 50 cents per pound, as aniline colors, under the similitude clause, although they are not aniline colors, not any more than other products now assimilated to aniline colors and paying the same duty.

If every article used in dyeing and calico printing were put on the free list, this would do away at once with the many vexatious difficulties resulting in appeals to the Secretary and in lawsuits, which are caused by the present complicated state of the tariff.

PHILADELPHIA, PA., October 16, 1882.

The following report of Mr. Geo. C. Tichenor, special agent of the Treasury Department, addressed to the Secretary of the Treasury, in regard to importations of foreign goods, having been referred to the Commission for its information, was ordered to be printed:

VOL. I—PP. 2486–2488. PAINTS AND DYES—ANILINE DYES AND COLORS (1350 Heyl)—Like the preceding provision, concerning "statuary," this one has provoked much discussion and controversy; has been variously construed by customs officers; has resulted in lawsuits, and has caused the department a vast amount of trouble and vexation. The tariff act of June 30, 1864, provided that "aniline dyes" should pay duty at one dollar per pound and thirty-five per centum ad valorem. At the period of the passage of this act the industry devoted to the production of these dyes was in its infancy and had scarcely developed beyond an experimental state. The products were

then derived exclusively, I believe, from a single hydrocarbon resulting from the distillation of coal tar, then exceedingly expensive, and which was called aniline—a mere arbitrary and accidental name, which owes its origin to the circumstance that its coloring principle was, I believe, first discovered by a Portuguese chemist, through the destructive distillation of indigo, which is known as "anil" in the language of Portugal. At that time (1864) these so-called aniline dyes were enormously expensive, had not entered into general use in the arts of dyeing and printing, and it was not thought that the high rate of duty would burthen our textile industries or be at all generally felt. It was also, probably, the intention to encourage and foster the production of these dyes in this country. It should also be borne in mind that we were then in the midst of the war period, and were legislating to increase our revenues. Dyes that were then worth in Europe say $30 per pound are now scarcely worth $3. So that at that time the specific rate of $1 per pound was a comparatively trifling matter.

The act of July 14, 1870, fixed the duty on "aniline dyes and colors, by whatever name known," at 50 cents per pound and 35 per cent ad valorem. Although great progress in the industry had been made by this time, and the cost and price of the dyes had been much reduced, they were still of high price, were being produced from the same source, and had not come into general use. Efforts had also begun to be made to build up the industry in this country, and the protective idea was in consequence perpetuated in the new act.

Within the twelve years past far greater progress has been made in this industry in Europe than in all previous time. In addition to reducing the cost of production and selling price of the original aniline dyes proper to a fabulous extent, and thereby vastly extending their use, a vast field of new and useful dyes have been produced from naphthalene and other coal-tar derivatives, which, coming from a cheaper source than aniline, have been produced at still diminished cost, and have come into quite general use as substitutes for many of the old vegetable and other organic dyes, including cochineal, logwood, and indigo, while madder has been almost entirely supplanted by a dye called alizarine, produced from anthracine; this latter dye having been originally classified as a manufactured article not otherwise provided for at 20 per cent ad valorem, the other newly-discovered dyes, produced from other coal-tar derivatives than aniline, were entered and largely passed under the same classification as alizarine, which also led to entering many colors mainly produced from aniline at the same rate of duty, while others again were entered and passed as paints, &c. The Department's attention having been brought quite fully to the subject, it was held in numerous decisions that dyes or colors produced from derivatives of coal tar other than aniline were subject to duty as "aniline dyes and colors," in accordance with the provisions of Section 2499 Revised Statutes, from which decisions and assessment of duties numerous appeals have been taken, and some suits brought for the recovery of duties in excess of 20 per cent.

Alizarine, so-called, was taken out of the controversy by the act of February 8, 1875, by being placed on the "free list" with "madder and munjeet," which it had largely superseded. All these coal-tar dyes are familiarly—commercially—known as aniline dyes, or aniline colors, and I can see no reason for putting alizarine on the free list that would not apply both to its older and younger associates, a number of which pay duty in excess of their actual cost in the country of production. I think no candid man who understands the subject will contend for a moment but that all these dyes, "by whatever name known," coming from any of the series of coal-tar hydrocarbons, should be subject to the same rate of duty so long as they remain dutiable; they all come from the same parent source, take the same place substantially in the arts, and are used for the same purposes; those being for coloring silks, woolens, cottons, jute, flax, leather, and other substances, as well as for the manufacture of different colored writing and printing inks, artists' and painters' colors, &c., in which manufactures they are in the nature of raw materials. It requires expert knowledge of the very highest order, aided by most exhaustive chemical analysis, to determine whether one of these dyestuffs, as imported, comes from aniline, naphthalene, or some other coal-tar product; so that they should all be included under one and the same head in the tariff. I incline to think a provision in substance as follows would meet the case, *viz.:* "All paints, dyes, and colors produced in whole or in part from coal tar or its derivatives." This, it will be seen, would include some articles, notably alizarine and picric acid, now on the free list, and hence would admit of a large reduction in the rate of duty without decreasing the aggregate amount of duty derived from dyestuffs. And since all these dyestuffs enter into the same uses as the large number of organic dyes and coloring matters now on the free list there is apparently no good reason why the latter should not, as well as the former, pay duty.

The experience of the last eighteen years has, I regret to say, shown that a high protective duty has not resulted in the building up of anything worthy of the name of an aniline color industry in this country, notwithstanding it is understood that there is an abundance of the raw materials here, and aniline oil and arseniate of aniline have been admitted free of duty. There are, to be sure, a few small concerns making certain classes of colors, but these employ so few people and produce such limited quantities of dyes as hardly to amount to an industry worth protecting at the expense, at least, of burthening and crippling the vast industries devoted to the manufacture of textile fabrics, as well as to putting a tax upon the consumers of such fabrics.

Having, after much inquiry and experience, ascertained beyond question that aniline dyes imported into the country have been largely undervalued, and that it is practically impossible to prevent such undervaluation so long as they are subject to an ad valorem duty high enough to present any inducement of consequence for undervaluing, I am convinced that it would be advisable to retain the specific feature with an ad valorem rate sufficient only to serve as an equalizer, and not to exceed 15 per cent. I have thought that 25 cents per pound and 15 per cent ad valorem would be as high rate as could be asked for purposes of protection. This would amount to near 40 per cent on a very liberal proportion of the dyes most used, and to about 60 per cent upon some of them.

I was informed while in Europe that the use of arsenic in the manufacture of all coal-tar dyes had been prohibited by the German Government, and perhaps by others, not only on account of the danger to the life and health of those engaged in their production, but also to those who wear garments and live in rooms where the carpets, curtains, and papered walls have been dyed or printed with such arsenic colors.

Revision of the Tariff

Hearings before the Committee on Ways and Means, 1889–90

NEW YORK, December 10, 1888.

PP. 393–398. *The Subcommittee on the Tariff of the Senate Committee on Finance:*

The undersigned manufacturers of coal-tar dyes beg leave to present the following statement with regard to the tariff bill now under discussion:

The great difference in the cost of raw material, both imported and domestic, and the still greater difference in the price of labor between here and Europe, makes it impossible for the home manufacturers to successfully compete with those of Europe, even if the duty of 35 per cent be actually paid.

Annexed schedule will show clearly the disadvantages under which we labor.

We also submit a statement of one of the largest factories in Europe showing their consumption of raw materials and products for one year, thus illustrating the importance of this industry for the United States, if fully developed by a protective policy.

In order to give the domestic manufacturer a safer protection, to enforce a strictly honest entry of values, and to insure the importation of the best quality of goods only, we suggest that a specific, or at least a partly specific duty be imposed.

To overcome the apparent difficulty of equalizing the duty on the various priced goods more justly, we propose to separate coal-tar dyes into two classes, which can easily be distinguished, and which would also separate the high-priced colors from the cheaper ones, *viz.:*

COAL-TAR DYES AND ACIDS OR BASES OF COAL-TAR DYES

Class I—Azo colors, picric acid, and naphthole yellow, 25 per cent ad valorem and 10 cents per pound gross weight.

Class II—Non-azo colors, 25 per cent ad valorem and 25 cents per pound gross weight.

Our authority for this classification is the list of coal-tar dyes as compiled by Gustave Schultz and Paul Julius, and published by R. Gaertner, at Berlin, in the year 1888.

This book not only gives the scientific and trade names, but also a description of the outward appearance of all coal-tar colors and their action when treated with certain named reagents, thus clearly establishing the identity of the respective dyes.

Very respectfully,

ALBANY ANILINE COMPANY
SCHOELLKOPF ANILINE AND CHEMICAL COMPANY
HELLER & MERZ
HUDSON RIVER ANILINE COLOR WORKS

We also beg to call your attention to the following: Under "paragraph 974" aniline oil is free. We would suggest to strike out the words "aniline oil" and insert the words "commercial aniline oils." All aniline oils are mixtures of several products, but the law as it now stands is liable to be misconstrued by the custom-house officials.

SCHEDULE SHOWING THE CONSUMPTION OF RAW MATERIAL AND PRODUCTS FOR THE YEAR 1887–'88, BY FARBWERKE, VORM. "MEISTER, LUCIUS AND BRUENING," AT HOECHST-ON-THE-MAIN

	Long tons		Long tons
Coal	64,230	Pyrites	12,661
Coal-tar products	3,624	Iron borings	1,503
Caustic soda	2,112	Methylated and ethylated spirits	309
Different potash salts	350	Various chemical products	1,635
Soda	1,610	Rock salt	10,518
Nitrate of soda	1,905	Lime	4,312

Should this factory be located in the United States 93 per cent of the above material would have to be produced in our country, 2 per cent nitrate of soda would come from South America, and of the remaining 5 per cent, consisting of "coal tar" and various chemical products, a large part, if not the whole, would also be manufactured in America.

To ship the manufactured products of above factory the following packages were used:

Casks	25,310	Bottles	803,200
Tins	1,962,000	Cases	25,310

The effect on the carrying of such an establishment can well be imagined.

This house was founded in 1863, and commenced operations with one 3 horse-power steam engine and 7 employees, which have been increased in the comparatively short time of twenty-five years to 1,840 horse-power and 2,062 employees.

SCHEDULE SHOWING EFFECT OF THE PROPOSED CHANGE OF DUTY ON THE PRICE OF THE MOST IMPORTANT COLORS NOW ON THE MARKET

CLASS I—Azo colors, etc.	Cost in Europe Cents	35% Cents	25% and 10 c. per lb. Cents
Orange Y	22	29.7	37.5
Orange R	25	33.75	41.25
Orange No. 4	60	81.5	85
Metanil yellow	75	101.25	103.75
Chrysoidine	40	54	60
Bismarck brown	72	97.2	100
Scarlet 2 R	27	36.35	43.25
Scarlet 3 R	34.5	46.57	52.1
Fast red	22	29.7	37.5
Crocein scarlet	47	63.5	68.75
Benzo-purpurine, 4 B	100	135	135
Chrysamine R	100	135	135
Hessian purple	100	135	135
Hessian yellow	100	135	135
	824.5	1113.52	1169.10

Cost in Europe, 100 per cent.
Present duty cost in United States, 135 per cent.
Proposed duty cost in United States, 142 per cent.

CLASS II—Non-azo colors	Cost in Europe	35%	25% and 25 c. per lb.
Auramine	$ 2.00	$ 2.70	$ 2.75
Victoria green	0.72	0.972	1.15
Acid green	1.00	1.35	1.50
Victoria blue	1.40	1.89	2.00
Fuchsine	0.84	1.13	1.30
Violet crystals	1.67	2.25	2.34
Violet 3 B	0.80	1.08	1.25
Cotton blue 5 B	2.90	3.91	3.875
Cotton blue B	1.50	2.02	2.125
Methylene blue	2.11	2.85	2.89
Eosine	1.25	1.635	1.81
Erythrosine	3.00	4.05	4.00
Rhodamine	5.00	6.75	6.50
	24.19	32.637	33.49

Cost in Europe, 100 per cent.
Present duty cost in United States, 135 per cent.
Proposed duty cost in United States, 138.4 per cent.
$(142 + 138.4) \div 2 = 140.2$.
$140.2 - 135.0 = 5.2$.
$\therefore$ Average higher duty under proposed duty = 5.2 per cent.

VIEWS OF FRED. KOEHLER

WASHINGTON, D. C., December 13, 1888.

The Subcommittee on the Tariff of the Senate Committee on Finance:

Mr. Pickhardt, in his statement regarding the manufacture of aniline colors in this country, having alluded to myself to sustain his assertion of the impossibility to make said dyes here, I beg leave to submit the following:

I was employed as chemist in the largest aniline-color factory in Germany and in the world from 1874 to 1883, and as such have had in my hands and am familiar with the manufacture of all aniline colors known up to that date. I subsequently was engaged for over five years in the aniline-color manufactory in this country, and I therefore believe myself more competent to judge about the possibility or impossibility of making colors here than Mr. Pickhardt. This gentleman having never been a manufacturer of coal-tar dyes himself, can only express the views of his friends in Germany about this matter or possibly the views they wish to impress upon your committee. If they really are convinced that aniline colors never can be profitably produced here, why are they not willing to let the American manufacturers die a natural death instead of trying to kill them quickly by having the duty removed, trying it even to the point of raising money among the German aniline-color manufacturers for that purpose? I, for my part, am firmly convinced that aniline colors can and will be made here, and, as a matter of fact, about 20 per cent of the home consumption are actually made here.

I am further convinced that had the duty not been lowered in 1883 not one pound of aniline color would be imported today.

It is true we did not succeed nearly as well as I expected, but that does not prove the impossibility to succeed finally. In the light of my knowledge of the circumstances under which this industry exists here and abroad, I find the reasons for its slow progress here chiefly as follows:

(1) In the very large difference in wages. An ordinary laborer in German aniline factories receives at the utmost 58 cents for

eleven hours' work, while we must pay from $1.25 to $1.75 for ten hours.

(2) In the large difference in the cost of raw material.

(3) In the difficulty we have in selling our goods. There are now about twenty agents of foreign manufacturers established in this country, who until recently have had practically the whole market, and whom we must undersell materially in order to procure any share of the market.

In conclusion, I would reiterate my statement that it is my firm belief that coal-tar colors can be made here, and it rests wholly with your honorable body to make the industry prosper or die out by tariff legislation.

Respectfully,

FREDERICK KOEHLER.

REMARKS ON MR. WILLIAM PICKHARDT'S TESTIMONY GIVEN BEFORE THE SUBCOMMITTEE ON THE TARIFF OF THE SENATE COMMITTEE ON FINANCE, DECEMBER 5 AND 6, 1888

Mr. Pickhardt does not contradict our statement that he charged $1 per pound over the European price. We are informed by the defendants in the suit that the patent had two years longer to run when the adverse court decision came, and other alizarine importers stated that Mr. Pickhardt could have had the patent two years longer if he had permitted the defendants and one or two others to share in the profits.

Page 8, b, line 8—Anthracene was formerly made here and could be made here again.

Line 16—The coal tar produced here is practically the same as that produced in London.

Page 9, b, line 9—Considerable coal-tar products are made in this country and used for coal-tar dyes and other purposes n spite of Mr. Pickhardt's decisive "No."

Page 12, line 15—How can the woolen mills of Rhode Island be retarded when the duty on the whole importation of coal-tar dyes used for cotton, wool, silk, paper, jute, lake colors, etc., only amounts to $400,000 per year? On all these articles the quantity of color used can not average 1 pound of dye to 100 pounds of material.

Page 13, line 8—If Mr. Pickhardt calls the stuff the New York Coal-Tar Company distills benzine, he tries to mislead. He must know this is commercial benzole—50 and 90 per cent used in the manufacture of coal-tar products. In fact, these are the standard grades produced by coal-tar distillers for the trade.

Line 13—On a previous page Mr. Pickhardt describes the process of distillation very minutely, and here he does not know what comes off first.

Page 14, line 17—Mr. Pickhardt says that his factory was only making 10 per cent on their capital. For the last four years they declared dividends of from $12^1/_2$ to 25 per cent after deducting large amounts for wear and tear, reserves, etc. His statement that an aniline factory would be useless for any other purpose is absolutely true. Mr. Pickhardt's statement that all azo dyes are made from naphthole and naphthalene and the aniline colors from aniline is incorrect and shows how very little he understands of the real nature of coal-tar dyes. The very first azo color discovered—amidoazo benzole—is a pure aniline color and contains not a trace of naphthole or naphthalene. The true characteristic of an azo dye is the fact that it contains the azo group N-N.

Page 15, line 10—If the patent has nothing to do with the price it is singular that alizarine red should have dropped $1 per pound as soon as the patent was practically declared void, page 7.

Page 19, line 9—Mr. Pickhardt's assertion that transportation from London to New York is as low as from London to Germany is not correct. It costs three times as much to New York as to Cologne on the Rhine.

Page 21, line 20—It is singular that Mr. Pickhardt can not state the difference in price of soluble and insoluble alizarine blue, as he imports and sells both. We protest against putting the alizarine colors on the free list. These colors, with free alizarine red, can be produced here as well as any of the coal-tar colors.

Page 5, c, last line—The Buffalo people never tried to sell their factory to Mr. Pickhardt or anybody else. The reason why the industry did not develop is because the duty was lowered in 1883 but not because we can not get the proper help.

Page 7, c—The reasons for the decline in prices of aniline colors are, first, cheaper raw material; second, improved methods and principally on account of the enormously increased output. Farbwerke, Meister, L. and M. produced in 1863, 10 to 14 pounds of magenta per day; in 1873 they produced 770 pounds per day.

Mr. Pickhardt's reply to Mr. Randall's letter—In 1883 Heller & Merz's ultramarine factory was about the third largest in the world and probably furnished 10 per cent of the world's consumption. The labor in aniline factories in the United States ranges from $1.25 to $1.75 per day for ordinary laborers.

We estimate the production of aniline dyes in the United States at 500,000 pounds, and the value at $500,000.

Mr. Pickhardt's statement regarding the number of men employed in this industry is probably correct. In this connection we may say that the Buffalo factory employed over one hundred men before the last reduction in duty. They now employ about one-half that number.

The production of aniline colors in Germany last year was in round numbers 13,000,000 pounds. Of this, one-ninth is exported to the United States. Seven-eighths of the entire output is exported.

The following is a pretty complete list of coal-tar dye factories in Europe: Germany, 18 factories; England, 6 factories; France, 6 factories; Switzerland, 6 factories.

It would be very desirable to have free alcohol, but for many purposes it should be free from admixtures such as methyl alcohol, camphor oil, etc.

Page 14—There is a decided difference between dye-wood and coal-tar colors. The first named are products of agriculture, while the latter are wholly manufactured articles.

Page 18—Mr. Pickhardt says here that in 1872, when he contemplated starting an ultramarine factory, nobody else had thought of it up to that time. He seems to have forgotten that he bought ultramarine from Heller & Merz several years before the date mentioned.

Pages 19 and 20—Not everybody seemed to have been of Mr. Pickhardt's opinion regarding the foolishness of starting an aniline factory here. As late as 1882 the general manager of Mr. Pickhardt's factory told Dr. Koehler that he considered America a good field for that industry then and he would come over himself if he had been younger. He told Dr. Koehler he did not consider the Americans crazy enough to lower the duty. Another authority on this subject is G. Schultz, who, in his book on coal-tar dyes, edition of 1882, says: "The tar in Russia and especially in America is developing. The latter country may soon be a serious competitor in this line to Europe."

Page 22—Mr. Pickhardt evidently wishes to convey the impression that our raw material is almost finished color. This is not the case by any means, as Mr. Pickhardt knows. With the exception of a few of the very largest, all the European factories buy their material in the same state as we do.

SCHEDULE SHOWING THE PRINCIPAL RAW MATERIALS USED IN AMERICAN COAL-TAR DYE FACTORIES, AND THEIR PRICES HERE AND ABROAD

Price per pound in	Europe	United States
Sulfuric acid 66°	$ 0.45	$ 0.95
Nitric acid 40°	4.75	5.50
Muriatic acid 20°	0.30	1.10
Aniline oil for blue	16.33	18.00
Aniline oil for red	15.00	16.50
Toluidine	15.00	19.50
Binitrobenzole	14.70	18.00
Binitrotoluol	14.70	18.00
Bichromate of soda	7.00	9.50
Salt	0.10	0.25
Naphthole	14.40	18.00
Nitrite soda	5.77	7.72
Alkali, 58 per cent	1.10	1.40
Iron borings	0.50	0.75
Caustic soda, 74 per cent	1.74	2.84
Labor per week	4.04	10.00
Total	115.88	148.01

The above list shows that we have to pay for our raw material and labor on an average 28 per cent more than it costs on the other side. If it is further considered that we are obliged to undersell imported dyes from 5 to 10 per cent, that our plant costs at least twice as much, the higher interest on capital and insurance, on plant and wear and tear of same, and the difference in scientific and clerical help, it will be plain to everybody that 35 per cent, even if fully collected, is an entirely inadequate protection. This assertion is borne out by the schedules given below, showing the different costs of a few of the principal colors in this country and abroad:

One week's production of safranine	Cost in Europe	Cost in U. S.
600 lbs. aniline oil	$90.00	$99.00
150 lbs. nitrite soda	8.64	11.58
2,400 lbs. muriatic acid	12.00	24.00
600 lbs. iron borings	3.00	4.50
960 lbs. whiting	3.84	5.76
1,110 lbs. bichromate soda	77.70	105.42
30,000 lbs. salt	30.00	75.00
Labor	16.16	40.00
Total	225.18	325.26
Wear and tear	11.26	32.52
	236.44	357.78
Per cent	100	151

One week's production of Bismarck brown	Cost in Europe	Cost in U. S.
900 lbs. binitrotoluol	$132.30	$162.00
1,910 lbs. muriatic acid, 20°	9.55	19.10
702 lbs. alkali, 58 per cent	7.72	9.83
2,400 lbs. iron	12.00	18.00
222 lbs. nitrite soda	12.81	17.14
1,200 lbs. salt	1.20	3.00
Labor	12.12	30.00
Total	187.70	259.07
Wear and tear	9.38	25.90
	197.08	284.97
Per cent	100	145

One week's production of orange	Cost in Europe	Cost in U. S.
660 lbs. aniline oil	$107.79	$118.80
1,710 lbs. sulfuric acid, 66°	4.29	16.25
345 lbs. alkali, 58 per cent	3.81	4.83
270 lbs. lime	0.54	0.54
396 lbs. nitrite soda	22.86	30.57
720 lbs. naphthole	103.68	132.60
600 lbs. caustic soda	10.44	17.04
2,100 lbs. salt	2.10	5.25
Labor	12.12	30.00
Total	267.63	325.88
Wear and tear[1]	13.38	32.58
	281.01	358.46
Per cent	100	128

One week's production of fuchsine	Cost in Europe	Cost in U. S.
4,188 lbs. aniline-oil	$628.20	$ 691.02
17,400 lbs. salt	17.40	43.50
210 lbs. alkali, 58 per cent	2.31	2.94
2,664 lbs. muriatic acid	13.32	29.30
1,900 lbs. nitrobenzole	190.00	237.50
Labor	40.40	100.00
Total	891.63	1,104.26
Wear and tear[1]	44.58	110.42
	936.21	1,214.68
Per cent	100	130

[1] In Europe 5 per cent; in United States 10 per cent.

TOTAL PER CENT FOR FOUR DYES	400	554
AVERAGE PER CENT FOR FOUR DYES	100	139

All of above calculations do not include salaries for chemists and office help, insurance on plant, interest on capital invested, etc., all of which items form a large part of the cost of the finished product, and cost at least twice as much here as they do in Europe.

Tariff Hearings before the Committee on Ways and Means, 1896–7

MONDAY, December 28, 1896.

PP. 57–61. Mr. SCHOELLKOPF submitted the following paper:

COMMITTEE ON WAYS AND MEANS, Washington, D. C.:

The undersigned coal-tar dye manufacturers of the United States respectfully submit that the following changes be made in the present tariff law:

Paragraph 14, which reads as follows: "Coal-tar colors or dyes, by whatever name known, and not specially provided for in this act, 25 per cent ad valorem," should be changed to read as follows:

"Coal-tar colors and dyes of every description not specially exempted by name, 35 per cent ad valorem."

The change in phraseology increases the clearness of the paragraph, and the increase in duty to 35 per cent is absolutely necessary to put the industry on a footing which will enable it to compete successfully with the foreign makers.

Article 443: "Coal-tar, crude, and all preparations except medicinal coal-tar preparations and products of coal tar, not colors or dyes, not specially provided for in this act, free."

This article should be changed to read as follows:

"Coal tar and all products and preparations of coal tar, not colors or dyes, except medicinal coal-tar preparations and such other coal-tar products and preparations which are specially exempted by name, free."

This phraseology makes the paragraph much clearer without, in any way, changing its meaning, and will avoid differences of opinion as to where certain products belong.

Article 368, which reads as follows: "Alizarine, natural and artificial, and all alizarine colors and dyes, free," should be changed to read as follows: "Alizarine, natural and artificial, free."

This is the way the paragraph stood in the act of 1883, and there is no reason whatever why alizarine colors, which are nothing more nor less than coal-tar colors, should be put on the free list any more than any other class of coal-tar colors.

The tariff of 1890 left the domestic coal-tar dye manufacturers in a very unfortunate position, with the duty of 35 per cent on the colors and 20 per cent on coal-tar preparations, which constitute a large percentage of the raw material for the colors. This, in addition to the higher prices we are compelled to pay for labor and other domestic chemicals, precluded any real progress of the American manufacturers in their struggle against the aggressive competition of the well-equipped German factories. The Wilson bill placed the coal-tar preparations on the free list, but by reducing the duty on the colors to 25 per cent did not improve the position of the domestic makers We feel confident that the slight increase asked for which makes the rate what it was under the tariff act of 1883 and 1890, will enable us, with the experience we have gained under adverse circumstances and with the great domestic progress in scientific chemistry, to successfully compete against the imported goods and in time supply the home market.

THE HELLER & MERZ CO.,
Henry Merz, *Treasurer.*
THE SCHOELLKOPF ANILINE AND CHEMICAL CO.,
By J. F. Schoellkopf, JR.
HUDSON RIVER ANILINE COLOR WORKS,
Louis S. Waldman, *President.*

The CHAIRMAN. What is the extent of this industry of coal-tar colors in this country?

Mr. SCHOELLKOPF. There are three plants with an aggregate capital of about a million dollars.

The CHAIRMAN. And how many employees?

Mr. SCHOELLKOPF. About 150 direct. Of course, the coal-tar dye industry is very large, in fact the largest consumer of crude chemicals, such as acids, etc., and in that way gives employment to a large number of hands indirectly.

The CHAIRMAN. About what proportion of the consumption of this country is produced here now?

Mr. SCHOELLKOPF. I would say about 20 to 25 per cent.

The CHAIRMAN. I see that the imports last year amounted to about $3,000,000.

Mr. SCHOELLKOPF. Well, I think that includes the alizarine red, also, as well.

The CHAIRMAN. It includes all dutiable coal-tar colors?

Mr. SCHOELLKOPF. Yes; I think that alizarine colors, which are coal-tar colors, of course, are included in that.

The CHAIRMAN. I presume so.

Mr. SCHOELLKOPF. I would like to mention that in this percentage I was not referring to alizarine red, which is on the free list now and always has been on the free list.

The CHAIRMAN. Are alizarine colors made in this country?

Mr. SCHOELLKOPF. They are not at present. They are on the free list at present and, of course, can not be made here. They could be made.

The CHAIRMAN. No attempt has been made to make them?

Mr. SCHOELLKOPF. They could be made.

The CHAIRMAN. Are there any special difficulties in the manufacture of these colors in this country?

Mr. SCHOELLKOPF. There are not now.

The CHAIRMAN. Growing out of the technical education which is required?

Mr. SCHOELLKOPF. That used to be the case formerly, but, of course, as I have stated in my paper, we have overcome these difficulties and are in a fair shape to capture the home market if we are sufficiently protected; and aside from the coal-tar products, which are on the free list, we consume vast quantities of other chemicals which are made in this country and can not be imported, such as acids, etc.

The CHAIRMAN. There is a great difference in the value of these materials?

Mr. SCHOELLKOPF. Yes, sir.

The CHAIRMAN. Therefore an ad valorem duty, perhaps, could be applied better than a specific duty could be applied?

Mr. SCHOELLKOPF. It would be rather difficult to apply a specific duty.

The CHAIRMAN. The prices ranging from what to what?

Mr. SCHOELLKOPF. Running from 20 to 25 cents a pound up to $15 a pound.

Mr. MCMILLIN. What will be the value of the product which will be affected by the change of from 25 per cent ad valorem to 35 per cent?

Mr. SCHOELLKOPF. You mean the value at present of the products of this country?

Mr. MCMILLIN. Yes, sir.

Mr. SCHOELLKOPF. I should say about $600,000 or $700,000.

Mr. MCMILLIN. And the present duty being 25 per cent, 10 per cent added to that is an increase of more than 20 per cent of the present rate. That would be a difference of between $100,000 and $200,000 added to the value of that product?

Mr. SCHOELLKOPF. I doubt very much whether it would add that much to the direct cost at the present time. We are not really able to compete at all, and while we are selling our colors we are not making anything on them, and we can not possibly make anything on them, and it is not so much we ask an increased duty to increase our prices greatly but simply to be better able to compete. It is not so much we want to increase the prices one or two hundred thousand dollars, but if we can increase our production we can produce cheaper if we are sure of this market, but if we must compete against twenty-five or thirty importers in New York, each one of whom represents a large manufacturing establishment on the other side, we must compete on even their terms and we must expect to get our proportion of the business which will be about 5 or 10 per cent, because this is our only market, and we can not manufacture on a sufficiently large scale to produce cheaply.

Mr. MCMILLIN. How many hands does your concern employ?

Mr. SCHOELLKOPF. We employ at the present between 60 and 70 hands.

Mr. MCMILLIN. And there are three concerns, representing the business of this country, I believe you stated, who employ about 150 hands?

Mr. SCHOELLKOPF. Some gentleman here can state that better than I can.

The CHAIRMAN. From what source of supply is crude tar product obtained—the residuum of the manufacture of gas?

Mr. SCHOELLKOPF. Yes, sir.

The CHAIRMAN. It comes from no other source in commercial quantities. Is it a by-product of the manufacture of gas?

Mr. SCHOELLKOPF. Yes, sir.

The CHAIRMAN. Has the supply of coal tar of this country been diminished by the extensive manufacture of water gas instead of coal gas?

Mr. SCHOELLKOPF. It has.

The CHAIRMAN. Is the supply insufficient in this country?

Mr. SCHOELLKOPF. The raw materials we use are an intermediate product between coal tar and coal-tar colors. There are certain products of coal tar which are intermediate, and those are the products which we use.

Mr. MCMILLIN. Is any considerable portion of this raw material imported?

Mr. SCHOELLKOPF. A very considerable proportion.

Mr. MCMILLIN. But you get your raw material free?

Mr. SCHOELLKOPF. Yes, sir.

Mr. MCMILLIN. You do not seek to add a duty to that?

Mr. SCHOELLKOPF. No, sir; we do not. In fact, we could not.

The CHAIRMAN. The reason is there is an insufficient supply of the by-product?

Mr. SCHOELLKOPF. That is one reason. Of course, we could not get along without a duty on colors. We would have to have an additional duty on colors if we put an additional duty on the raw material.

ANILINE COLORS AND DYESTUFFS

Statement of F. E. Atteaux & Co., of Boston, Mass.

BOSTON, MASS., January 9, 1897.

COMMITTEE ON WAYS AND MEANS:

We beg leave to present in brief our reasons for requesting that a duty be placed upon all colors commercially known as alizarine colors, with the exception of true chemical alizarine.

We are domestic manufacturers of so-called alizarine colors and dyestuffs, and have our works at South Boston, Mass. Our plant there is valued at about $75,000. We have been in this business a number of years, and are manufacturing a line of colors which come into competition with the so-called alizarine colors which are imported to this country. In the last ten years we have spent over $20,000 experimenting, and we are now able to make a considerable number of colors which do the work of the imported colors. We feel that we are entitled to consideration and that our interests ought to be considered by your committee in framing this bill.

BENEFITS THE DOMESTIC CONSUMER

In 1890, when we commenced to manufacture the color which we call alizarine violet, and which took the place of the foreign alizarine violet, the imported color was sold in this market at 75 cents a pound. Today it is being sold at 28 cents a pound, and the reduction has been largely due to our competition. We make in the same way alizarine green, so called, and this comes in competition with the imported veridine, or coeruline. The importers were selling this color at that time at about 48 cents a pound. Today, largely in consequence of our being able to manufacture a similar color, the price has fallen to 25 cents a pound. These are only two instances of cases which may be amplified to show your committee what has been the effect of our presence as manufacturers in this market. In addition to these two colors we are now manufacturing five other so-called alizarine colors, to wit, Blue B., Blue G. S., Blue R., Brown O., and Brown R. These colors come into competition with and take the place of imported alizarine blue and brown.

The foreign colors are patented, as is well known, and the prices charged here and abroad for the same article have greatly varied, at the expense of the American consumer.

It is well known to the coal-tar color trade that prior to 1888 a certain firm of importers in this country was charging $1.25 per pound for alizarine which was sold all over Europe at 25 cents. As long as we are not able to produce these colors, the complete control of the market will enable the foreigner to charge a price without reference to the cost, and based entirely upon the needs of the consumer and his inability to obtain the color from any other source. In this connection, we beg leave to refer your committee to the statements made and testimony taken July 7, 1888, before the subcommittee on the tariff of the Senate Committee on Finance, and printed on page 268.

The fact that the imported colors are patented does not make it impossible for us, under equal conditions, to compete with these articles, as we have been able in the past and expect in the future to make colors which will do the work of the imported colors and not infringe upon their patent rights. If we can do this, it will be seen that it will be of large benefit to the domestic consumer, as the patent has been in the past the means of keeping up the prices artificially in this country. As soon as we have been able to make a color that did the work of a foreign color we have found that the importers have been compelled to bring their prices down and to sell at or below our price; and this price of ours being based upon the cost of manufacture has given the consumer the benefit of a large reduction in the artificially sustained price.

DUTY ON RAW MATERIAL AND NOT ON THE MANUFACTURED ARTICLE

In our industry we are confronted with conditions imposed by the tariff which are a reversal of the usual methods of protection. We are paying 25 per cent duty on the articles which we import and use as the material for making our colors. We are compelled to sell the colors which we manufacture in competition with the so-called alizarine colors which are entered without duty by the importers. We use at present as our raw material imperial blue, chrome orange, and naphthol yellow, and on these we pay at the custom-house 25 per cent duty as coal-tar colors.

In addition to this, it may be stated that our labor costs at least double that of Europe, we paying $1.50 a day while the same class of labor can be had there at 75 cents a day. As we have heretofore stated, this is a direct reversal of the theory of protection of a new industry, and we feel that if we are compelled to pay a duty of 25 per cent for that which enters into our complete product the article which is not manufactured and with which we are now competing should pay at least the same rate of duty * * * *.

Tariff Hearings before the Committee on Ways and Means, 1908–1909

WEDNESDAY, November 11, 1908.

VOL. I—PP. 128–130. Mr. SCHOELLKOPF. I represent the Schoellkopf, Hartford, Hanna Company, of Buffalo, N. Y., and the Heller & Merz Company, of Newark, N. J. I have prepared a short brief, which I will read.

(Reads:)

BUFFALO, N. Y., November 9, 1908.

Hon. SERENO E. PAYNE,

Chairman Ways and Means Committee.

DEAR SIR: The undersigned respectfully request that at the impending revision of the tariff the minimum duty on coal-tar colors and dyes be increased from 30 per cent to 40 per cent ad valorem, and that all coal-tar products and preparations not colors or dyes used in the manufacture of these dyes be placed on the free list.

In submitting this request we do so with the understanding that it is the intention of Congress so to adjust import duties as to give the domestic manufacturer adequate protection against his foreign rival; or, in other words, the duties imposed shall cover the difference in cost of the article protected when made in America as against the same article when made abroad.

In asking for free entry of all coal-tar products and preparations used in the manufacture of coal-tar colors, no American industry will be injured, as these articles are not made in the United States, nor can they be manufactured profitably under existing conditions.

In order to prove that our demands, as outlined above, are not unreasonable we have prepared the following tables:

Table A—Showing cost of coal-tar dye plant in America and Germany, designed for a yearly output of 3,000,000 pounds; also showing the cost for depreciation on buildings and wear and tear on machinery and interest on investment.

Table B—Showing number of employees required and their salaries for such a plant in America and Germany.

Table C—Showing material required to produce 3,000,000 pounds of color and cost of same under present tariff; also under tariff as proposed by us; also cost of same material in Germany.

Table D—Showing comparative cost of 3,000,000 pounds of color when produced in Germany; also cost when produced under present tariff; also cost when produced under tariff as proposed by us.

By referring to Table D it appears that taking the cost of colors in Germany at 100 per cent, the same colors cost to produce in America under the present tariff 144.1 per cent, and in case all coal-tar preparations should be admitted free, the cost would still be over 134.4 per cent. That our figures are correct is positively proven by two highly significant facts.

First. These same colors are now being imported from Germany and sold in this market for less than it costs us to produce them, even omitting charges for depreciation and interest on investment.

Second. By the fact that German manufacturers do not manufacture in the United States because, as people high in authority state openly, they can manufacture the colors in Germany and lay them down in the United States, with duty of 30 per cent and manufacturer's profit added, at a lower price than they could manufacture the same colors in America.

By referring again to the same table it appears that under the proposed tariff the cost of colors would be only 35 per cent higher than the same colors when made in Germany, while we are asking for a duty of 40 per cent. It should be borne in mind, however, that in the first place the American manufacturer, in order to secure the home market, must be in a position to undersell the importer, and in the second place, the foreign manufacturer, when driven to it, will always assume part of the duty himself. The result would be that with a duty of 40 per cent the American manufacturer could not hope to realize more than 30 per cent in excess of what the same goods are sold for in Germany, and probably considerably less. In any event, therefore, even with a 40 per cent duty, the American manufacturer would have to content himself with a considerably smaller profit than his German rival.

Since the present tariff went into effect American coal-tar dye manufacturers have striven strenuously to capture the home market, and while they have succeeded in increasing very materially their output, they have done so at no profit to themselves. Whenever the domestic production of any one color increased sufficiently to interfere seriously with the sale of the imported product, the foreign manufacturers dropped prices to a point that compelled the American manufacturer to sell at cost or even lower.

On the other hand, colors not made in America and controlled by the foreign manufacturers, either through patents or combinations, were not only not reduced, but in many instances

actually increased in price. Eliminate American competition, and prices, even with a reduced duty, will rise and not fall. We refer to such products as alizarines, aniline salt, aniline oil, beta naphthol, etc., which during the past few years have been advanced from 15 to 50 per cent, although the cost of production has not risen.

TABLE A—SHOWING COST OF COAL-TAR DYE PLANT DESIGNED FOR A YEARLY OUTPUT OF 3,000,000 POUNDS; ALSO SHOWING THE COST OF DEPRECIATION OF BUILDINGS AND WEAR AND TEAR ON MACHINERY, ETC.

Cost of plant in	U. S.	Germany
For land	$50,000	$50,000
For buildings	100,000	60,000
For machinery, tools, etc	380,000	250,000
For working capital	500,000	350,000
Total cost of plant	1,030,000	710,000
Depreciation on buildings, 5 per cent	5,000	3,000
Wear and tear on machinery, etc., 10 per cent	38,000	25,000
Interest on investment, 6 per cent	61,800	42,600
	104,800	70,600

TABLE B—EMPLOYEES NEEDED FOR A COAL-TAR DYE PLANT WITH A YEARLY CAPACITY OF 3,000,000 LBS.

	United States		Germany	
	Rate	Amount	Rate	Amount
1 general manager	$10,000	$10,000	$5,000	$5,000
2 head chemists	5,000	10,000	2,500	5,000
4 chemists	1,500	6,000	1,000	4,000
1 chemist	1,300	1,300	800	800
1 chemist	900	900	600	600
3 dyers	1,144	3,432	390	1,170
1 helper	468	468	160	160
1 helper	312	312	135	135
2 boys	208	416	78	156
1 head bookkeeper	2,500	2,500	1,200	1,200
1 clerk	1,800	1,800	900	900
1 clerk	1,200	1,200	600	600
3 clerks	900	2,700	450	1,350
1 clerk	780	780	350	350
2 boys	500	1,000	250	500
1 telephone operator	364	364	160	160
1 superintendent	1,560	1,560	750	750
1 shipping clerk	1,200	1,200	450	450
2 engineers	1,040	2,080	520	1,040
6 firemen	780	4,680	390	2,340
2 watchmen	728	1,456	390	780
2 teamsters	624	1,248	390	780
4 carpenters	780	3,120	390	1,500
2 machinists	936	1,872	468	936
2 blacksmiths	676	1,352	468	936
4 helpers	624	2,496	260	1,040
10 foremen	718	7,180	390	3,900
83 laborers	540	44,820	300	24,900
TOTAL		116,236		61,493

TABLE C—MATERIAL REQUIRED FOR 3,000,000 LBS. OF COAL-TAR DYES AND COST OF SAME

CHEMICALS USED	Quantities in lbs.	Cost in U. S. under Present tariff	Cost in U. S. under Proposed tariff	Cost in Germany
Nitrite soda	385,803	$29,899.74	$29,899.74	$23,919.79
Muriatic acid	1,369,125	10,268.43	10,268.43	8,214.74
Sulfuric acid	122,814	409.38	409.38	327.50
Carbonate soda	790,875	7,592.40	7,592.40	6,073.92
Caustic soda	111,942	2,417.94	2,417.94	1,934.35
Common salt	3,371,280	5,899.74	5,899.74	4,719.79
Sulfide sodium	4,800	65.61	65.61	52.49
Ammonia 26°	2,880	144.00	144.00	115.20
Mono - ethyl - alpha-naphthylamine	4,437	1,668.30	1,387.89	1,110.31
Aniline oil	139,041	16,128.75	16,128.75	12,903.00
Paranitroaniline	68,445	16,426.80	13,680.00	10,951.20
H-acid	593,145	206,414.46	172,605.21	138,084.17
Alpha naphthylamine	54,270	4,205.94	4,205.94	3,364.75
R-salt	29,295	4,247.79	3,544.71	2,835.77
Amido-G—salt	35,910	9,605.91	7,989.96	6,391.96
Freund's acid	9,630	1,661.16	1,396.35	1,117.08
Cleve acid	4,032	695.52	584.64	467.71
Gamma acid	12,420	5,464.80	4,558.14	3,646.51
Salicylic acid	18,720	4,867.20	2,822.97	2,258.38
A B Sp Sa	47,952	5,591.19	5,072.22	4,057.78
A A Tm Ba	19,908	4,411.62	4,081.14	3,264.91
A A Bm Ba	104,625	22,965.18	21,228.09	16,982.47
A A Tm S	23,400	7,317.18	5,974.02	4,779.22
Tolidine	25,740	8,494.20	8,494.20	6,795.36
Benzidine	218,340	66,047.85	66,047.85	52,838.28
TOTAL	7,568,889	442,911.09	396,508.32	317,206.64

TABLE D—COST OF PRODUCING 3,000,000 LBS. OF COAL-TAR DYES

Materials, labor, fuel, etc.	When made in United States under present tariff	When made in United States under proposed tariff	When made in Germany
Materials	$442,911.09	$396,508.32	$317,206.64
Fuel	20,250.00	20,250.00	27,000.00
Labor	116,236.00	116,236.00	61,493.00
Interest on investment	61,800.00	61,800.00	42,600.00
Depreciation of plant	43,000.00	43,000.00	28,000.00
Taxes, fire insurance, and incidentals	8,000.00	8,000.00	4,000.00
	692,197.09	645,784.32	480,299.64
Per cent	144.1	134.4	100

TABLE E

PRESENT WORDING	NEW WORDING SUGGESTED
SEC. 15—Coal-tar dyes or colors, not specially provided for in this act, 30 per cent ad valorem; all other products or preparations of coal tar, not colors or dyes and not medicinal, not specially provided for in this act, 20 per cent ad valorem.	Coal-tar dyes or colors, not specially provided for in this act, 40 per cent ad valorem.
FREE LIST	
SEC. 469—Alizarin, natural or artificial, and dyes derived from alizarin or from anthracin.	No change suggested.
SEC. 524—Coal tar, crude, pitch of coal tar, and products of coal tar known as dead or creosote oil, benzol, toluol, naphthalin, xylol, phenol, cresol, xylidin, toluidine, cumidin, binitrotoluol, binitrobenzol, benzidin, tolidin, dianisidine, naphthol, naphthylamin, diphenylamin, benzaldehyde, benzyl chloride, resorcin, nitrobenzol, and nitrotoluol; all the foregoing not medicinal and not colors or dyes.	Coal tar, crude, and all products or preparations of coal tar, not colors or dyes and not medicinal, not specially provided for in this act.
SEC. 580—Indigo.	No change suggested.

In conclusion, we beg to state that the figures and tables contained in this document are taken from our books, and represent actual conditions, and if desired we are prepared to prove the correctness of same in every particular.

On a separate sheet annexed hereto, marked Table E, we suggest the wording of the sections in the tariff which we desire to have changed.

Respectfully submitted,

SCHOELLKOPF, HARTFORD & HANNA COMPANY
THE HELLER & MERZ COMPANY

P. 143. NEW YORK, November 20, 1908.

Hon. SERENO E. PAYNE,
Chairman Committee on Ways and Means,
House of Representatives.

At a meeting of the firms interested in and dealing in "coal-tar colors or dyes" and "coal-tar products not colors or dyes, not otherwise specially provided for," held here to-day, the following resolution was unanimously adopted:

Resolved, That we, the undersigned, protest against any increase in the duties on coal-tar colors or dyes, by whatever name known, or coal-tar products not colors or dyes, not otherwise specially provided for, and request an opportunity to be heard individually at such time and place as is convenient to the committee of Congress.

H. A. METZ & CO., H. A. Metz, *President.*
CASSELLA COLOR COMPANY, G. W. J. Matheson.
BADISCHE COMPANY, Adolf Kuttroff, *President.*
FARBENFABRIKEN OF ELBERFELD COMPANY,
Y. Rellmerling, *President.*
A. KLIPSTEIN & CO., G. O. Klipstein, *Treasurer.*
BERLIN ANILINE WORKS, E. O. Patz, *Second Vice-President.*
GEIGY ANILINE AND EXTRACT COMPANY,
Alfred Küblein, *Vice-President.*
WALTER F. SYKES & CO., Jno. A. McGuire, *Attorney.*
GEISENHEIMER & CO.
C. BISCHOFF & CO.
KALLE & CO. (incorporated), Wm. Junker, *Secretary.*

P. 146. MEMORIAL AND PROTEST IN OPPOSITION TO ANY ADVANCE IN DUTIES ON COAL-TAR COLORS AND DYES

WASHINGTON, D. C., December 20, 1908.

COMMITTEE ON WAYS AND MEANS,
Washington, D. C.

GENTLEMEN: Your memorialists, cotton manufacturers, consumers of coal-tar dyes for the coloring of various cotton fabrics (the largest consuming industry of coal-tar dyes in the country) respectfully submit:

First. We desire to protest against any advance in the rates of duty on coal-tar dyes or colors under Section 15 of the present tariff on the ground that such advance would—

(*a*) Increase the cost of manufacturing colored cotton goods in the United States.

(*b*) Increase the price to the consumer in the United States.

(*c*) In the case of export trade an advance in the cost of any of our raw materials adds to our burden and minimizes our opportunity to compete with foreign cotton manufacturers in foreign markets.

Second. We further petition that, for the same reasons, alizarines and dyes derived from alizarin and anthracene, as well as indigo, be left upon the free list, and that no change be made in the following schedules now on the free list:

Section 468. Alizarin, natural or artificial, and dyes derived from alizarine or from anthracene.

Section 580. Indigo (meaning vegetable and synthetic).

Very respectfully,

AMOSKEAG MFG. CO.,
F. C. Dumaine, *Treasurer*, Manchester, N. H.
HAMILTON MFG. CO.,
Franklin D. Williams, *Assistant Treasurer*, Lowell, Mass.
PACIFIC MILLS,
Edwin F. Greene, *Treasurer*, Lawrence, Mass.
MASSACHUSETTS COTTON MILLS,
Edward Lovering, *Treasurer*, Lowell, Mass.
MERRIMACK MFG. CO.,
Herbert Lyman, *Treasurer*, Lowell, Mass.
COCHECO MFG. CO.,
H. DeF. Lockwood, *Treasurer*, Dover, N. H.
AMERICAN PRINTING CO.,
B. H. Borden, *Treasurer*, Fall River, Mass.
THE UNITED STATES FINISHING CO.,
J. H. Wright, *President*, New York.
THE APPONAUG CO.,
J. H. Wright, *President*, Apponaug, R. I.
GARNER & CO.,
Oscar Hutley, *Vice-President*, Pleasant Valley, N. Y.
PASSAIC PRINT WORKS,
Edward E. Poor, *Treasurer*, Passaic, N. J.
ARNOLD PRINT WORKS,
W. A. Gallup, *Treasurer*, North Adams, Mass.
WINDSOR PRINT WORKS,
D. A. Russell, *General Manager*, North Adams, Mass.
RENFREW MFG. CO.,
Ira S. Ball, *Assistant Treasurer*, Adams, Mass.
QUEEN DYEING CO.,
B. J. Horton, *Treasurer*, Providence, R. I.
S. H. GREENE & SONS CORPORATION,
Francis W. Greene, *Treasurer*, Riverpoint, R. I.
THE ASPINOOK CO.,
L. Johnson, *Treasurer*, Jewett City, Conn.

The hearings of 1913 both before the Committee on Ways and Means and the Senate Finance Committee were of the same general tenor as the statements just given.

The duties on coal-tar dyes in the different tariff revisions were:

1864—Anilin dyes $1.00 per lb. and 35 per cent.
1870—Anilin dyes 50 c. per lb. and 35 per cent.
1883—Anilin dyes 35 per cent. Alizarin, free.
Anilin oil and salts, free. Indigo, free.
1890—Same as 1883 with alizarin *dyes* added to Free List.
1894—Coal-tar dyes, 25 per cent. 1897—Coal tar dyes, 30 per cent.
Alizarin dyes & indigo, free. Alizarin dyes & indigo, free.
Anilin oil & salt, free. Anilin oil & salt, free.
1909—Same as 1897.
1913—Alizarin & alizarin dyes, free. Coal tar dyes, 30 per cent.
Indigo & indigo dyes, free. Carbazol dyes, free.
Anilin oil and salts, toluidin, xylidin, etc., 10 per cent.

It is therefore clear, in the light of the above tariff-enactments, that the preceding arguments of dye-users *against* suitable tariff-enactments on coal-tar dyes so as to enable their manufacture in this country, were more persuasive with Congress than the arguments of domestic dye and chemical makers *on behalf* of such favorable tariff-enactments.

Will the awakening of the American public since August, 1914, alter this situation?

90 WILLIAM STREET, NEW YORK CITY

THE HEATING OF COTTONSEED—ITS CAUSES AND PREVENTION

By E. H. R. BARROW

Received June 19, 1915

On the subject of heating and deterioration of cottonseed in storage, and the accompanying reactions, there has been very little work and no published data, so far as I have been able to find. The losses which may be directly attributed to this deterioration have been enormous during the course of development of the cottonseed industry, frequently amounting to many millions of dollars in a single season, and diverting from its natural uses as edible products, many millions of tons of products which thus become suitable only for the soap kettle and as fertilizer. The heating of cottonseed has been regarded as the inevitable result of conditions beyond the control of the producer or manufacturer, and until quite recently little thought has been given to controlling these conditions and arresting the tendency of cottonseed to heat, and in this manner conserving the edibility of the resultant products.

It is generally known, however, that the heating of cottonseed is due, primarily, to excess of moisture. The cottonseed is composed, essentially, of a germ or embryo, together with a supply of reserve material from which the future plant is derived. The embryo is the only living portion of the seed—destroy this embryo and the life of the seed is destroyed. While the presence of moisture induces germination, other important circumstances materially effecting the process are temperature, access of oxygen, and removal of carbon dioxide.

The presence of moisture is very essential and sufficient moisture is necessary to induce germination, the effect being one of softening and swelling of the cellular structure, accompanied by a rise in temperature. As a general rule seeds of all kinds undergo very little change when they do not contain an excess of moisture; when not already dry, they continue to lose moisture until a relatively normal equilibrium of moisture content is established, in which condition they are subject to little change and retain their vitality for long periods. We are familiar with the ordinary keeping qualities of cottonseed stored in a good sound condition, without excess of moisture, when for a period of several months there is very little change in the physical characteristics and only slight increase in the amounts of free fatty acid. The presence of the fine coating of closely adhering lint makes the cottonseed peculiarly susceptible to the absorption and retention of relatively high percentages of moisture. The results of many moisture determinations of the separated kernels and hulls are conclusive evidence that the hulls to which the lint adheres are almost invariably from 1 to 5 per cent higher in moisture than the kernel, as illustrated by the averages of several thousand seed analyses covering the past six years.

MOISTURE IN	HULLS	KERNEL	SEED	
1914.....	13.82	9.48	11.42	Bad
1913.....	13.88	8.38	10.84	Bad
1912.....	13.02	8.17	10.29	Good
1911.....	13.84	10.20	11.82	Bad
1910.....	11.96	7.58	9.51	Good
1909.....	12.85	7.63	9.88	Good

Concurrent with the averages showing the highest moisture content is the fact that the seed of those years showed a marked tendency to rapid heating and deterioration, whereas in the other years there was very little low-grade product made, due to heating. As to the normal moisture content of cottonseed, or the

limit of moisture which seed may contain without undergoing heating, it is not possible to say with positiveness in the light of our present knowledge and insufficient data, but that a definite relationship does exist between the moisture content of seed and their keeping qualities is an indisputable fact. My observations have been that it is not safe to store for any length of time seed containing 10 per cent of moisture, and that a moisture content of 11 per cent or over would cause the seed to heat very rapidly. More extended observations and investigations along this line would be valuable.

When the moisture content is above the normal, thus providing suitable conditions to induce germination, and the seeds are accumulated in large bulk, the chemical changes are set in motion in the embryo of the seed, and these reactions are accompanied by a rise in temperature, at first slowly, then, as a flame spreads, so the combustion proceeds more rapidly, involving larger areas and may produce a warmth favorable to the incipient germination of seed containing even a normal amount of moisture. This result has frequently been observed in seed sheds where perhaps one car-load of wet seed will get into a large pile, commence heating and rapidly spread to other parts of the pile, even though composed of sound seed. It is also common knowledge that heating once begun will infect larger areas unless promptly checked, out of which knowledge has grown the common practice of using long steel rods in seed piles, and promptly "working up" the hot seed located in this manner. If all of the circumstances favorable to germination were present in the seed pile the process would go on there as it does when the roots and leaves are developed in the soil; in other words, the seed would "sprout." However, the compactness of the seed pile prevents the free access of the air, or oxygen, and the exhaling of carbon dioxide, two essential details of germination, and as a result of the slow embryonic combustion, the fats and carbohydrates are partially consumed, whereas the proteid matter remains undiminished in quantity.

As a practical illustration of this phenomenon the oil yield of badly damaged, heated seed is often reduced from 5 to 15 gallons per ton less than normal, whereas the by-product cake will analyze as high in nitrogen as undamaged seed, but of course the color would be dark.

Again it must be borne in mind that seed germination can take place only within definite temperature limits and that this range of temperature is different for different seeds, as a rule there being no germination below 35° F., or above 115° F. Then how must we account for the much higher temperature to which cottonseed will heat under favorable conditions, if left undisturbed?

As a further contributing cause to the deterioration of cottonseed must be added the important influence of microörganisms. We know that not only aerobic but the spores of anaerobic microörganisms are present everywhere so that it is only necessary to furnish favorable conditions and all the latent life collected in millions of bacteria will start to act, developing the reactions which we commonly call putrefaction. In putrefaction we find both oxidation and reduction processes. It is comparable to digestion where, in the body, the heat and energy is derived from the breaking up and utilization of the complicated molecules of fat, carbohydrates and proteids of our food. Likewise the decomposition, or putrefaction of similar molecules in the supplies of reserve material found in the seed, is accompanied by the evolution of heat. When the heat developed by the destruction of the complicated organic molecules has reached a temperature favorable for the process of oxidation we find pure chemical reactions which may raise the temperature to the point of ignition.

The presence of large proportions of fat in the seed, under the influence of moisture and the rise in temperature induced by embryonic and enzymic changes, brings about a concomitant reaction, whereby the glycerides of the fat are broken up into their corresponding fatty acids, and glycerine set free, accompanied by the evolution of heat. This action is accelerated by the presence of the cellular substance of the seed.

I have kept accurate records of the rise of temperature in various piles of seed and have found that from 60 to 85° F. the rise is very gradual, sometimes requiring from 2 to 3 weeks; however, when 85° is reached the rise becomes very rapid, showing increases of 10° or more in 24 hours. This readily accounts for the fact that many have observed where rods pulled from a seed pile one morning and showing "barely warm," may be found next day to be "hot," according to the crude method of controlling seed in storage. I am not prepared to name the maximum temperature to which cottonseed may heat, but I have recorded temperatures of 190° F. I am not aware of any cases of spontaneous combustion in piles of cottonseed, but it is of course well known that spontaneous combustion frequently occurs in cottonseed hulls in bulk. Allen records a maximum temperature of 284° C. in 1 hour and 35 minutes; in experiments with cottonseed oil in Mackey's "Cloth Oil Tester,"[1] all oils that attain a temperature of 200° C. in less than 2 hours in this test are regarded as dangerous. Spontaneous combustion of waste saturated with cotton oil frequently occurs.

Having reviewed briefly some of the fundamental causes of the heating of cottonseed in storage we shall now look to the control and prevention of this condition.

Cottonseed will not heat if given free access to air by spreading in thin layers upon a floor surface or dividing the storage shed into small compartments, whereby a ventilation of the seed may be obtained. But on account of the enormous space requirements either of these plans have been found impracticable without enormously increasing the storage capacity. Other systems of ventilation have been tried with little success, such as perforated pipes distributed at intervals through the pile and providing a means of circulating a current of air. Removing the excess of moisture by drying has been given some attention recently, and there is now on the market a drying apparatus which has found some favor and is being operated in some mills. The chief objections to this system are its cost of installation and operation, its limited tonnage capacity, the heavy loss in weight due to evaporation of moisture and the "setting" of the color of the oil if the drying is permitted to go too far.

The keeping qualities of cottonseed may be greatly improved by thoroughly cleaning before storage, and removing all bolls, dirt, trash, etc.—a practice to be commended where the seed receipts of a mill would not overtax the capacity of the seed cleaning machinery.

For a number of years I have given much thought to this subject and conducted numerous experiments along the lines above mentioned, with the result that my researches led to the conclusion that the ideal control of the heating tendency of cottonseed would be a method adaptable to all of the varying conditions in different mills, of unlimited tonnage capacity, of small working cost and without the necessary tying up of capital in expensive machinery operative only when seeds are in bad condition—a method by which the heating tendency would be checked or overcome without incurring enormous manufacturing losses in weight and whereby the quality of the resultant product would not be impaired or rendered unmerchantable.

Various chemicals and substances having hygroscopic properties were tried out with varying successes, concurrent with carefully observed records of temperature and analyses of the seed at different stages. These experiments included the use of iron sulfate, sodium nitrate, copper sulfate, salicylic acid, borax and boracic acid, sodium carbonate, calcium chloride,

[1] *J. Soc. Chem. Ind.*, **15** (1896), 90.

formaldehyde, magnesium carbonate, pipe clay, and sodium chloride (common salt).

In each instance the results obtained with different percentages of salt and salt brine were highly gratifying and led to further and more elaborate experiments along these lines. These experiments extended over relatively long periods of time and the effect of the treatment was so salutary that an effort was at once made to adapt the experiments to a larger and more practical scale. Then it was that one of the usual vicissitudes of an inventor was encountered; not owning an oil mill myself, and finding even my most intimate friends to be skeptical, and indifferent to becoming pioneers, it was with great difficulty that an opportunity was found to reduce the process to treatment. About this time a providential act occurred in the sinking of the steamboat Shiloh at the Memphis wharf. As part of its cargo this boat carried 4000 sacks of cottonseed. In the opinion of insurance adjusters and experienced oil mill men these seeds were regarded as a total loss even should they be recovered from the wreck. Although it seemed a foolhardy experiment, a proposition was made to attempt to preserve these seeds for oil milling purposes should they be secured. After being submerged from 10 days to 3 weeks, part of this seed cargo was brought to the surface and stored upon the levee, finally being removed to an old warehouse where the treatment was applied. During the few days on the levee these seed rapidly attained temperatures ranging from 100° to 160° F. and were completely saturated with water.

Sacks of these seeds untreated became a foul-smelling mass of decomposed substance in a very few days. The effect of the treatment was to immediately check the tendency to heat, and by occasional stirring, notwithstanding the enormous excess of water, the semblance of the seed was retained, and they were kept in this manner for a period of three months. On account of the large quantity of water present, which it was never possible to materially reduce, a number of mechanical difficulties were encountered in the working of them, and of course the quality of the product was "off." It is very probable, too, that the cost of handling these seeds did not make it profitable, nor is it recommended that this method be adopted to prove the efficacy of this process. However, admitting the severity of the test, it is quite remarkable that anything remained at the end of three months but a foul-smelling mass of putrefaction and decomposition. This experiment served its purpose.

At the opening of the season 1914–15 many mills, despite a warning, loaded up on hot seed. In the meantime more plausible experiments had demonstrated the means of successfully controlling this tendency to heat. In the application of this treatment I have found that it is best to apply the salt in the dry powdered form as the seeds are passing through the conveyors, either in unloading from the cars or in moving from one place to another in the seed-shed. A very simple proportioning machine, devised by Mr. F. C. Holly of Memphis, was found to give excellent results in making the application. The agitation of the conveyor produces a very thorough mixing, resulting in each seed being given a thin coating of salt, provided of course, the particles are fine enough. Three important details are very essential to the successful operation of the treatment: (1) the initial temperature of the seed in storage; (2) the salt must be very finely divided; (3) the salt must be dry and loose.

It must be borne firmly in mind that this treatment is not curative, but preventive; and that the quality of the seed can be made no better than they are at the start. For the most part seed treated the past season had already undergone considerable damage from heating. In unloading from cars or moving these hot seeds in the house through the conveyors, there is always a marked reduction in temperature, due to the airing. The longer the conveyor, and the lighter the feed, the greater the drop in temperature.

(1)—It is possible to handle seed showing 150° F. through 100 feet or more of conveyor, and by regulating the feed reduce them to atmospheric temperature. This is the usual method applied in mills having hot seed, except that there being nothing added to check the heating tendency, after a short time these seed usually become heated again. It has already been pointed out that seeds heat very slowly up to 80° F., then commence to heat very rapidly; therefore in applying this treatment it is very important to cool the seed in the conveyor as much as possible, and always below 80° F. This gives time for the saline solution to permeate the seed and get in its work.

(2)—In order that the seed may be thoroughly coated without using too large a quantity of material, it is necessary to have the salt very finely ground. The commercial grades on the market were found to be too coarse to give successful results, and as the tendency of finely ground salt is to absorb moisture, become lumpy, and eventually solidify, it was found necessary to manufacture a special grade for this purpose.

(3)—The function of the salt being to absorb part of the contained moisture of the seed it is very important and quite essential to success to have a loose, very dry material. Again the commercial grades were not satisfactory, and it was necessary to add certain harmless drying substances to counteract the deliquescence of the salt, and retain for a reasonable time the original condition of the manufactured product, thereby improving its effectiveness and cost of handling without materially adding to its cost.

The first effect of the application of the preserving material is to the average oil mill man quite alarming. The moisture of the seed is rapidly brought to the surface and for a period of from one to three weeks the seed go through a "sweat," and appear very damp and moist. The salt has now partially gone into solution in the moisture of the seed, forming a saturated brine solution. By continual contact this saline solution gradually permeates the seed coating by osmosis. Salt being an enemy to the process of germination and antiseptical towards the enzymic ferments or decomposing microbes within the cellular structure of the seed, the process of heating is thereby checked by arresting the cycle of developments due to chemical and bacterial activities. As to the proportion of salt preservative to be added, good results have been obtained with approximately 5 per cent by weight, proportionately to the seed; however, the exact proportioning is not important, and it is only necessary to have an excess in order that the seed may again become dry after going through the initial "sweat." This excess adhering to the outer surface of the seed is removed during the various seed-cleaning operations before the seeds are passed to the mill to be crushed.

Only such salt remains in the seed as is actually absorbed and is approximately as follows:

	Per cent	Per ton seed
Whole seed, 1 ton	1.25	25 lbs.
Lint, 80 lbs.	5.00	5 lbs.
Hulls, 750 lbs.	2.5	16.5 lbs.
Meal, 850 lbs.	0.5	4.2 lbs.
Oil	None	None

Of the 100 lbs. applied per ton of seed, approximately 25 lbs. are taken up by the seed, the remainder, 75 per cent, being removed in cleaning. Moisture determinations in the impure salt recovered average 10 per cent. Therefore, assuming that the salt was originally moisture-free, there is removed from the seed 7.5 lbs. moisture and a gain in absorbed preservative of 25 lbs. representing a net gain in weight of 17.5 lbs. per ton of seed.

During the past season's operations such data as were available have been collected. However, by reason of the fact that the bulk of the treated seed was worked by mixing with untreated seed, the opportunity for the collection of a large amount of comparative data was not altogether favorable. Especial attention has been given to the possible effect of this treatment

upon the manufacturing losses and with particular reference to the quality and grade of the manufactured product. Careful observations have also been made of the manufacturing problems, if any, which might be encountered in working the treated seed. In this latter respect the experience of the operating superintendents has been unanimous that the difficulties encountered are far less, by comparison, than the many difficulties of working heated seed. The only objection so far offered was a slightly diminished capacity of conveyors; a tendency to occasionally clog the boll screens at one mill, and the alleged tendency of the salt to rust certain exposed parts of the operating machinery and gin ribs at another. It is generally admitted by these superintendents that these difficulties were immaterial and could be easily remedied by allowing the seed to remain long enough to be in condition, and working a few tons of untreated seed before the "clean up."

COTTONSEED

A number of analyses were made of the seed at the time of treatment and when working to ascertain the per cent of damaged and the available oil content. These analyses showed practically no increase in damaged seed and no falling off in available oil yields.

COTTONSEED MEAL

The regular analyses of the mills showed no falling off in the extraction of oil when working treated seed and in every mill as good analytical results were shown on meal from treated seed as untreated. Quantitative estimations of chlorine have shown the presence of from 0.1 to 0.8 per cent of sodium chloride. It has been claimed by Dr. Battle that a small percentage of salt added to the meals in cooking increased the flow of oil and gives a better extraction. I have so far failed to note this effect in working treated seed. The addition of about 1 per cent of salt to most manufactured feeds increases their palatability and tends to prevent fermentation and moulding; therefore, the presence of these small amounts in the meal would be a decided advantage.

COTTONSEED HULLS

The application of the preservative being external, as would be supposed, the larger percentage of sodium chloride is found in the hulls, and lint. The hulls being used principally as a roughage feed, in quantities from 10 to 15 lbs. per day, the amount of salt contained therein is important. It has been found that the absorptive properties of different lots of cottonseed vary so that the percentage of sodium chloride found in unmixed treated seed has ranged between the limits of 0.5 to 4 per cent. In feeding hulls from treated seed it would not be necessary for the feeder to supply the usual quantities of salt to his stock and the purchaser should be informed by the mill that the hulls contain all the salt necessary. Careful inquiry has been made of dairymen and feeders using these treated hulls. They have invariably reported no injurious results but on the other hand that the stock apparently ate the hulls with greater relish. Aside from increasing the palatability the presence of the salt unmistakably adds to the keeping qualities of the hulls and prevents the well-known tendency of excessive moisture hulls to heat and deteriorate. At one of the mills in Memphis a pile of about 100 tons of hulls from treated seed remained cool and sweet in storage, while in the same shed another pile of hulls from untreated seed was hot and smoking and had to be forked over to prevent spontaneous combustion. The fact that salt is also frequently used in fireproofing inflammable materials should make it evident that treated seed and hulls would constitute a lower fire risk, and that the process would have the endorsement of fire underwriters.

LINT

At first no appreciable effect was noticed upon the lint. As the treatment progressed further, attention was called to comparison of linter samples from the same mill working untreated and treated seed. This comparison both as to color and texture appeared most favorable towards the lint from treated seed and it was actually found that buyers were willing to pay a better price for such lint, on account of the peculiar firmness of texture imparted by the treatment. Microscopic examination failed to show the presence of but occasional minute salt crystals, whereas by chemical analysis from 2 to 5 per cent of sodium chloride was found to be present. This amount is undoubtedly held partially in solution in the capillary wall of the lint, and being a saturated solution would tend to deposit minute salt crystals with any loss in moisture. At ordinary temperatures 100 parts of water dissolve 36 parts of salt; consequently about 4.5 per cent of sodium chloride would indicate a saturated salt solution if the lint contained 12 per cent of moisture.

CRUDE OIL

Only minute traces of salt have been found in the oil from treated seed and a number of samples failed to show a qualitative reaction. The property of salt to coagulate albuminous matters is well known. Its effect, if any, upon the meal would be to act concurrently with the heat of cooking in the coagulation of the proteid matters, with the result that the expressed oil would contain less impurities which hasten its deterioration and increase the refining loss. Coincident with this theory is the average result of 12 oil samples compared with average results of 50 oils of the previous season containing the same amount of free fatty acid and reported by different operators.

	Average of 50 samples Oil season 1913–14 Analyzed by different operators	Average of 12 samples Treated seed From Mill No. 1
Free fatty acid.....	6.93 per cent	7.1 per cent
Refining loss.....	20.5 per cent	17.1 per cent
Color (red).....	15.35	12.1

Insufficient data make it impossible to substantiate this theory further at the present time. It is a common practice in refineries to use salt for the improvement of flavor of oils and aid in the process of refining, so that its presence in treated seed would tend to improve its quality.

The process, as described, is the very essence of simplicity. Its intelligent use may prove the means of overcoming in the future the great losses which many mills have incurred from this source in the past. The protection of this work by Letters Patent is to conserve its use to the great number of oil mill interests in this great industry.

MEMPHIS, TENN.

OBITUARIES

JOSEPH A. HOLMES

Dr. Joseph A. Holmes, Director of the United States Bureau of Mines, died in Denver, Colorado, Tuesday, July 13th, at 1 o'clock in the morning, after an illness of about one year. His death was due to tuberculosis which it is thought was brought on through a too great devotion to his duties.

Dr. Holmes was born at Laurens, S. C., November 23, 1859. He graduated at Cornell University in 1880.

During and following his college course, Dr. Holmes devoted especial attention to chemistry, including the chemistry of explosives, and to metallurgy, geology, electricity and general physics, surveying, and mining. He visited mining regions and

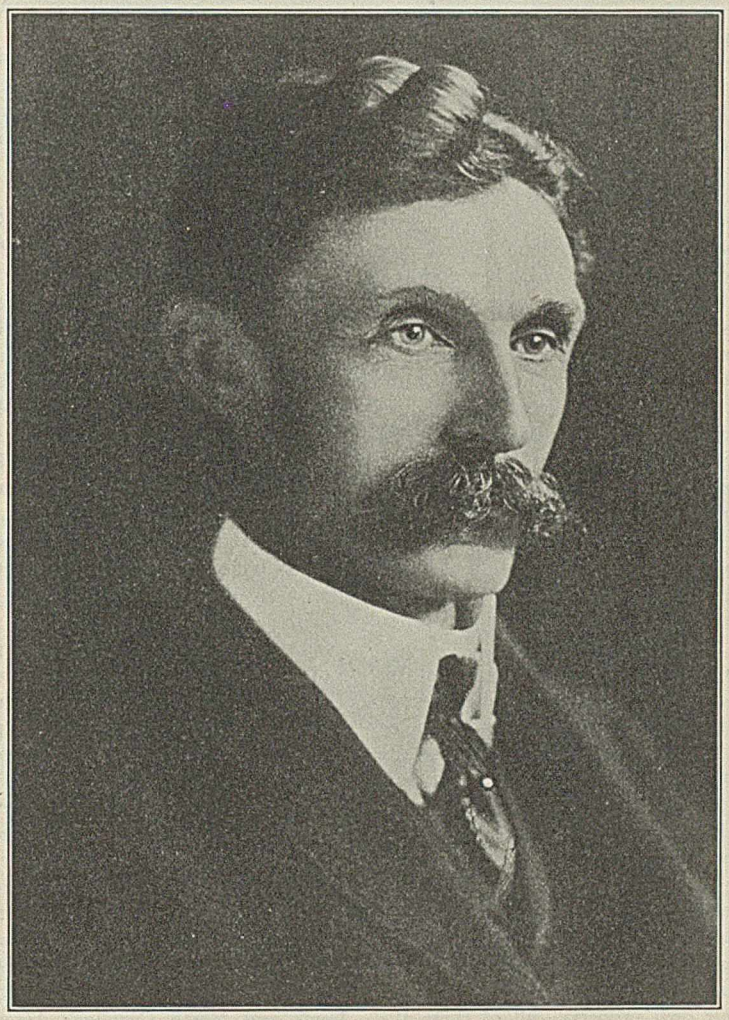
examined iron, copper, and other metal mines, coal mines, quarries, etc., and plants for the treatment and preparation of mineral products in many parts of the United States, in Germany, France, Belgium, and Great Britain.

In these foreign countries, as well as in the United States, Dr. Holmes studied the methods of mining with special reference to lessening the loss of life and waste of resources. For ten years, from 1881 to 1891, he was professor of geology in the University of North Carolina and State Geologist from 1891 to 1903. As professor of geology, he examined many mines in a professional way and gave much attention to quarrying, metal mining, and metallurgical operations.

In 1903 and 1904, he organized and had charge of the Department of Mines and Metallurgy at the St. Louis World's Fair, planning the exhibits of mining and metallurgical operations.

In 1904, when the government fuel investigations were authorized by Congress, Dr. Holmes, having planned the work, was offered its supervision, but being unable to give it the necessary time, at his request the supervision was placed under a committee consisting of two members of the Geological Survey and Dr. Holmes. Under this committee the investigations were carried on to the end of 1904.

Early in 1905, the Director of the Survey appointed Dr. Holmes to take individual charge of the fuel investigations as enlarged and continued, and of the investigations of mine explosions, that were first authorized in 1907. These, developed during 1905 to 1910 under the Geological Survey, were on July 1, 1910, transferred to the newly-created Bureau of Mines. The work under the Geological Survey was carried on by the Technologic Branch, of which Dr. Holmes was chief. During this time and before the Bureau of Mines was created, Dr. Holmes examined the mine-experiment stations and mine-rescue stations in Great Britain, France, Belgium and Germany, studying their equipment and methods, and as a result of his study inaugurated the movement for mine-rescue work in this country by private operators, by States and by the Federal Government.



JOSEPH A. HOLMES

At that time he planned the establishment of three State mine-rescue stations in Illinois and of the Government mine-rescue experiment stations located at points accessible to the principal coal fields of the country. Afterwards he extended these mine-rescue experiment stations until they are now located in both coal-mining and metal-mining regions of the country.

In 1907, on Dr. Holmes' recommendation, President Roosevelt secured the appointment by the governments of Great Britain, Germany and Belgium of one distinguished engineer from each of these countries to visit the United States; and in company with these engineers Dr. Holmes visited the more important coal fields of the country to determine the extent to which safety practices used in other mining countries might be introduced in the United States.

On the basis of their findings, Dr. Holmes organized and directed the government investigations of mine explosions, of explosives used in mining, and the use of electricity in mining. He took personal part in the rescue work after many of the mine disasters occurring in the United States from the beginning of the work under the Geological Survey until about one year before his death.

In connection with his work for the Geological Survey, Dr. Holmes had charge of the structural-materials investigations which were inaugurated during the Louisiana Purchase Exposition. While this work was under his direction, he conducted a number of notable investigations into the value of various structural materials with especial reference to their fire-resisting qualities. He was perhaps the pioneer in calling general attention to the large per capita fire waste in this country and undoubtedly aided much in the campaign which has been continued ever since to reduce it. Under his initiative, the United States Geological Survey at the time issued a report entitled "The San Francisco Earthquake and Fire of April 18, 1909, and Their Effects on Structures and Structural Materials," a report that has since served as a guide to foreign countries in rebuilding cities destroyed by earthquakes. Other important publications on structural materials were: "The Fire-Resistive Properties of Various Building Materials," and "The Fire Tax and Waste of Structural Materials in the United States."

When the Bureau of Mines was created in 1910, the structural-materials investigations were turned over by Congress to the Bureau of Standards, which has carried them on ever since.

Dr. Holmes' work under the Geological Survey also included fuel investigations which were started by him at the Louisiana Purchase Exposition and led to a remarkable quickening of public interest in the values of fuels. The work of the coal-testing plant at the Exposition was reported in Professional Paper 48, "Report on the Operations of the Coal-Testing Plant of the United States Geological Survey at the Louisiana Purchase Exposition, St. Louis, Missouri, 1904," and several other papers.

After the close of the Louisiana Purchase Exposition, the United States Geological Survey under the direction of Dr. Holmes continued work at the fuel-testing plant at St. Louis, Mo., and as a result published a number of important papers. Bulletin 339, "The Purchase of Coal under Government and Commercial Specifications on the Basis of Its Heating Value, with Analyses of Coal Delivered under Government Contracts," published in 1908, gave impetus to a movement throughout the United States for the purchase of coal under specifications as to quality as shown by analysis. The plan was adopted by the United States Government which today purchases $8,000,000 to $10,000,000 worth of coal yearly on such a basis.

With the creation of the Bureau of Mines and the appointment of Dr. Holmes as Director, the work he had planned under the Geological Survey developed rapidly. Congress widened the scope and enlarged the purposes of the bureau, and authorized a work more nearly commensurate with the importance and the needs of the world's greatest mining industry.

The chief work of the Bureau of Mines under Dr. Holmes has been the investigation of problems having to do with the cause and prevention of coal-mine explosions and the safeguarding of the lives of coal miners.

Dr. Holmes found that both the improper use of explosives and the use of improper explosives had resulted in coal-mine disasters; he demonstrated, what many mining men had doubted, that coal dust might be as dangerous to the miner as firedamp, and after some time he established a list of "permissible" explosives for use in mines in which dust or gas were a menace to the miner. These explosives were designated as permissible after they had passed rigid tests at the experiment station of the bureau, which had been established at Pittsburgh, Pa., and when used as prescribed by the bureau. The protection these explosives give the coal miner is shown by a statement of the bureau's engineers that since 1908 there has been only one serious explosion in a mine where permissible explosives were used. Dr. Holmes also took up the investigation of better lights for miners and established a permissible list of portable electric lamps for use in dangerous mines. Thousands of these lamps are now in daily use.

Dr. Holmes in developing rescue work introduced in this country the so-called oxygen-breathing apparatus, and as a result of his efforts such apparatus is not only widely used but is being adopted by manufacturing establishments and by city fire departments. There are today six mine-rescue stations and eight mine-rescue cars and one rescue motor truck operated by the bureau, and there is federal legislation to increase the number of stations each year. Today 170 mining companies have individually or through the association of two or more companies established 76 mine-rescue stations at which there are now 1,200 sets of artificial breathing apparatus besides the auxiliary equipment for first-aid and fire-fighting work. There are also 12 mine-rescue cars now operated by individual mining companies about their own property—all of these the result of the incentive given by Dr. Holmes to this work.

The investigations of the Bureau of Mines into causes of disasters and the recommendations made by the bureau and the coöperation received from the State mine inspectors, mine operators and miners have resulted in a decreasing death rate in the mines since the work was taken up by the Federal Government.

It was Dr. Holmes who aroused the coal-mining industry to the danger of dust explosions. At the experiment station of the bureau in Pittsburgh through his efforts a large steel tube was constructed for demonstrating the explosibility of coal dust. While foreign countries had paid much attention to the danger of coal dust and while it was known in this country that coal dust was dangerous, little attention was being paid to the prevention of such explosions until Dr. Holmes demonstrated how violent they might be. As some mining men were unconvinced of the great danger from coal dust, believing that what happened in a tube might not happen in a mine, Dr. Holmes developed an experimental coal mine at Bruceton, Pa., twelve miles from Pittsburgh, the only experimental mine in the world. For more than four years demonstrations have been going on in this mine until today the entire mining industry, including operators and miners, has a well-settled idea of the danger of coal dust, and mine operators and State officials are following the recommendations of the bureau to prevent dust explosions.

In the last two years, the work of the bureau under Dr. Holmes has included metallurgical investigations which are of especial importance to the West. These investigations have so far been confined to general inquiries and to a few investigations dealing with such topics as smelter-smoke wastes at smelters and other metallurgical plants, and wastes in the treatment of rare minerals and metals. Under the supervision of Dr. Holmes, chemists and engineers of the bureau have demonstrated that a process they have devised for the extraction of radium from its ores can be successfully used on a commercial scale and will prove more efficient than that used by the largest foreign producers of radium. Through this process it is possible that the cost of radium to the consumer will be greatly reduced. The process is to be patented and dedicated to the public.

Dr. Holmes on many occasions showed the need for such investigations and told the mining industry that the total wastes or losses in mining and utilizing our mineral resources amount to more than $1,000,000 a day.

He told the country that the coking of coal in bee-hive ovens is resulting in an annual loss of $75,000,000. The progress made in reducing some of this loss through the use of by-product ovens and the utilization of the by-products is described in a recent report of the Bureau of Mines.

The Director showed also that the annual waste of metals in brass-furnace practice amounted to over $4,500,000 and the bureau issued a report showing how this waste can be largely prevented by practical means.

Dr. Holmes organized the first national mine-safety demonstration which was held in Pittsburgh, Pa., 1911, before President Taft and other notables and 20,000 miners. The slogan "Safety First" was used for the first time generally at this demonstration and shortly afterwards spread rapidly throughout the mining industry and now it is known throughout every industry in the country.

In 1908, when President Roosevelt took up the question of conservation of our natural resources, Dr. Holmes was made a member of the National Conservation Commission and had charge of the inventory of the nation's mineral resources.

Dr. Holmes was a member of the Mining Legislation Commission of Illinois; American Institute of Mining Engineers; American Society for Testing Materials; Elisha Mitchell Society; Washington Academy of Science; Academies of Science of St. Louis and North Carolina; American Society of Mechanical Engineers; Cosmos Club of Washington; Engineers' Club of New York; and a fellow of the Geological Society of America.

He received a degree of D. Sc. from the University of Pittsburgh, and that of LL. D. from the University of North Carolina, both degrees being conferred as a result of Dr. Holmes' efforts in behalf of the mining industry.

In the death of Dr. Holmes, the people of the United States lose one of their most remarkable and efficient public servants. And the saddest part of it all is that Dr. Holmes is a victim of overwork, a too great devotion to the duties which had been assigned to him in behalf of the safety of the million miners in the United States. He was one of the most enthusiastic, indefatigable workers I ever had the pleasure of associating with. His mind was continually upon the yearly death toll of the miners, and although taken away in the prime of his life he has already

accomplished much in reducing the terrible death rate. In the last five years of his life he saw a slowly but steadily decreasing death rate and while it gave him much joy, it only added to his almost superhuman efforts in behalf of the men.

It is thought that Dr. Holmes' frequent visits to mines in which there were disasters and his continual insistence on going where only his trained rescue crews should go, sharing the dangers that should have gone only to more robust men, seriously affected his health. On his trip to Alaska two years ago to learn concerning the great coal fields there he met with many hardships and severe exposure and it is believed that this hastened his end.

Dr. Holmes is indeed a martyr to the cause of safety among the miners, and his name is added to the honor roll of three bureau rescuers who in the past gave up their lives to this cause. The mining industry suffers a keen loss in his death.

VAN. H. MANNING

ALBERT PLAUT

The death of Albert Plaut, on June 17th, at his apartments in the Hotel Ritz-Carlton, New York, was a great shock to his large circle of friends and business acquaintances, and a serious loss to the chemical profession, in which he was so well and favorably known. He was an active member of the American Chemical Society and of the Society of Chemical Industry. He served as a delegate, appointed by President Taft, to represent the United States at the Seventh International Congress of Applied Chemistry in London, and was a member of the Executive Committee and Chairman of the Entertainment Committee of the Eighth International Congress held in New York.

ALBERT PLAUT

Mr. Plaut gave much time and energy to the development of the Chemists' Club of New York. He was personally active in the building of the present new Club House and was at the time of his death Treasurer of the Club and a member of its Board of Trustees. The portrait of Priestley, which hangs in the social room of the Club, was presented by him, and many other features of the Club owe their origin or existence to his interest and generosity. At a special meeting of the Board, held on the day after his death, the following minute was adopted:

"The death of our Treasurer and fellow member of this Board, Albert Plaut, inflicts upon the Chemists' Club and its members a very great loss. His unflagging interest in the Club's affairs, his generous helpfulness on every occasion that offered itself, his keen interest in the work of chemists, and his encouraging appreciation of those efforts, his sturdy maintenance of what he regarded as right, together with his gracious good fellowship, all endeared him to the large number of us who knew him. And while we record our poignant grief at his passing, we are glad to acknowledge both appreciation and pleasure in that ours was the privilege to be associated with one who ordered his life to such good ends and whose friendship was indeed a benediction to those who shared it.

"This Board extends its sincere condolences to his bereaved family, and directs that a copy of this minute, properly engrossed, be sent to it."

At a special meeting of the Directors of the Chemists' Building Company held June twenty-first, the following Minute was unanimously adopted:

"In the death on June seventeenth, one thousand nine hundred and fifteen, of Mr. Albert Plaut, Vice-President of this Company, a Director since its organization, and one of the moving spirits in the generous group that made possible the present club house for the chemists of this country, not only this Board has suffered the loss of a close friend, and wise counsellor, but the chemical world as well is deprived of one whose integrity of purpose, genial personality and wide interests have made for him a lasting place in the hearts of all who enjoyed the privilege of knowing him.

"*Resolved*, that a suitably engrossed copy be transmitted to the bereaved family of our lamented fellow, with the expression of this Board's personal grief and deepest sympathy in their loss."

Mr. Plaut was preeminently successful in his commercial undertakings, and was recognized as a leader among the merchants of New York. The firm of which he was the head became, under his administration, one of the leading pharmaceutical houses in America. He was Past-President of the National Wholesale Druggists' Association, First Vice-President of the Merchants' Association, a founder of the Metropolitan Drug Club and of the Druggists' Supply Corporation, an active member of the New York Drug and Chemical Club, and past-chairman of the Drug and Trade Section of the New York Board of Trade and Transportation.

Born in Eschwege, Germany, in 1858, Mr. Plaut came to the United States with his parents when eleven years old and received his education in the public schools of New York City, the College of the City of New York, and the New York College of Pharmacy. He served a five-year apprenticeship with his father, Isaac Plaut, in the drug business, after which he entered the firm of Lehn & Fink as a stock clerk. He was admitted to

partnership in this Company in 1886, on the retirement of Mr. Lehn. In 1910 Lehn & Fink was incorporated, with a capital of $600,000, and Mr. Plaut became President of the concern. The business structure at 120 William Street was erected by Mr. Plaut in 1901 and the factory and general laboratory in Brooklyn were established by him in 1906.

Mr. Plaut showed a keen interest in educational work. He served many years as trustee of the New York College of Pharmacy and was at the time of his death First Vice-President and Chairman of the Committee on Instruction of that institution. In 1914 he founded the Isaac Plaut Travelling Fellowship, in memory of his father, to be awarded annually to the post-graduate student who had shown special aptitude for original investigation. The holder of the fellowship receives a stipend of $500 for a year's study in some foreign university. Mr. Plaut also established an endowment fund of $5,000 for the Princeton Chemical Club in order to enable its members to enjoy the advantages of outside lectures on special chemical topics. During his lifetime he was a generous supporter of many other charitable and educational institutions in New York.

He left a large estate which, after ample provision for his employees and numerous charitable bequests, is to be shared by his son, Edward Plaut, who succeeds to his business interests, and his daughters, Mrs. M. J. Falk and Miss Constance Plaut.

The funeral services were held at the Society for Ethical Culture Hall, and the interment was made in the cemetery at Point Pleasant, New York. The honorary pallbearers were I. Frank Stone, President of the National Aniline & Chemical Co.; Thomas F. Main, President of Tarrant & Co.; Wm. J. Schieffelin, President of Schieffelin & Co.; William C. Breed, President of the Merchants' Association of New York; Berthold Levi and Francis F. Holliday, representatives of the National Wholesale Druggists' Association; Professor M. C. Whitaker, President of the Chemists' Club; Frederick William Fink, former partner in the Lehn & Fink Corporation; Franklin Black, of Charles Pfizer & Co.; and F. L. Lavanburg.

M. C. WHITAKER

CURRENT INDUSTRIAL NEWS

By M. L. HAMLIN

WORLD TRADE IN FERTILIZERS

L'Institut International d'Agriculture has published in Rome (September, 1914) a pamphlet containing very complete data, chiefly in tables, of the production, movement and consumption of various classes of fertilizers.

Those figures which concern the United States are the following, the amounts being given in metric tons (approximately equal to United States long tons):

	1912	1913
PRODUCTION		
Natural phosphates:		
Extracted	3,231,636	3,202,636
Sold	3,146,573	3,020,905
Ammonium sulfate	149,700	176,900
Calcium cyanamide(*a*)	14,000	14,000
Sulfur	308,328	316,575
Copper sulfate	17,908	24,643
IMPORTS		
Guano	19,467	19,411
Bone meal, etc.	34,704	35,173
Potassium sulfate	44,071	40,172
Potassium chloride	218,751	217,191
Manure salts(*b*)	694,133	600,168
Sodium nitrate	444,134	635,876
Ammonium sulfate	54,016	59,670
Synthetic nitrogenous fertilizers	2,339	.....
Sulfur	27,315	14,870
EXPORTS		
Natural phosphates	1,225,824	1,388,362
Potassium chloride	620	708
Miscellaneous fertilizers	75,780	73,911
Sulfur	27,315	14,870
Copper sulfate	3,097	1,910
CONSUMPTION		
Artificial fertilizers	5,575,392	6,169,736
Potassium-containing products(*c*)	215,966	231,690
Sodium nitrate	441,047	589,187
Nitrogen fertilizers:		
As sodium nitrate	.....	485,000
As ammonium sulfate	.....	235,000

(*a*) Capacity of plants. (*b*) Min. 20 per cent K_2O.
(*c*) Calculated on basis of pure potash.

The pamphlet also contains tables showing market prices at different times and places and concludes with an extensive bibliography.

TOLERANCES IN TESTS OF PERMISSIBLE EXPLOSIVES

At the invitation of Van. H. Manning, Acting Director of the United States Bureau of Mines, a number of the prominent manufacturers of permissible explosives used in coal mines met in conference at the Bureau of Mines offices in Washington, June 7th, to discuss the tolerances that may be permitted in tests of field samples or manufacturers' samples of permissible explosives.

At the request of Mr. Manning, Dr. Charles E. Munroe, consulting explosives chemist of the Bureau of Mines, presided at the conference and explained its objects. Addressing the manufacturers he said: "Today there are 133 different explosives on the permissible list. There have been others admitted to the list and later removed. In all, over 150 explosives have been tested by the various methods and the results carefully recorded in the archives of the bureau. It was found that the bureau could not rest content with simply testing the original samples submitted and saying that hereafter that was a permissible explosive provided it was used in the manner described by the bureau. It was felt that in order that the bureau might know that the explosives were of the proper kind, samples should be obtained in the field and that such samples should be tested by the same methods. When this was undertaken, the question came up as to how nearly the tests should conform to the results of the tests made on the original samples. It is well known that it is physically impossible for a man to exactly duplicate results in two tests. After a large amount of data had been gathered, a committee was appointed by the Director to consider the problem; the committee has been working on the matter for a long time, the data have been tabulated, and have been thoroughly investigated by the members of the committee. The results were set forth in a report to the Director, a copy of which has been sent to all manufacturers of permissible explosives and you are here to discuss that report today. The committee felt it was necessary to determine these tolerances before proceeding with the investigation of explosives in the field and before saying that they did or did not conform to the requirements. We should have complete agreement between the manufacturers and the Bureau of Mines in regard to this retesting of explosives."

The questions submitted by the committee of the bureau were taken up in detail and the tolerances recommended and agreed upon at the conferences are as follows:

In order to define more exactly what is meant by the phrase "similar in all respects" in the definition of a permissible explosive, *viz.:* "An explosive is called a permissible explosive when it is similar in all respects to the sample that passed certain tests by the United States Bureau of Mines, and when it is used in accordance with the conditions prescribed by this bureau," the following tolerances are recommended for field samples or manufacturers' samples of explosives, beyond which such lot of explosives can not vary and still be considered permissible for use in coal mines: *Provided*, that where the Bureau of Mines finds a sample which does not come up to the tolerance limits, the bureau shall simply declare that particular lot of explosives not permissible, and a copy of the notification to the

consumer or owner shall be furnished the manufacturer, the notification to state that the explosive did not meet the tolerance requirements for moisture or ingredients.

CHEMICAL ANALYSIS

MOISTURE, to be fixed by a sliding scale of from 1.5 per cent at zero to 4 per cent at 10 per cent of moisture in original sample, this tolerance being on total percentage of moisture in the explosive.

OTHER INGREDIENTS (or their equivalents) in quantities not exceeding 60 per cent, according to attached curve. For ingredients in quantities of 60 per cent or more, the tolerance shall be plus or minus 3 per cent: *Provided*, that the ingredients of a permissible explosive shall be considered to be those substances reported as found by the Bureau of Mines in the original sample of that explosive submitted for test as to its permissibility; and *Provided further*, that an equivalent shall be considered to be a substance which would not materially alter the properties of the explosive and which would produce the same result as the original substance.

PRODUCTS OF COMBUSTION (determined by Bichel gauge test): The volume of poisonous gases from 680 grams of the explosive including its wrapper must be less than 158 liters, except that in case the first test yields 158 liters or more of poisonous gases per 680 grams of the explosive (including its wrapper), the average result of three tests agreeing within 5 per cent of each other shall be taken and no explosive shall remain permissible when this average for poisonous gases exceeds the above standard limit.

PHYSICAL TESTS

RATE OF DETONATION (the average of three trials with Mettegang's recorder): plus or minus 15 per cent.

UNIT DEFLECTIVE CHARGE (the average of three trials with the ballistic pendulum): plus or minus 10 per cent.

GRAMS OF WRAPPER per 100 grams of explosive (average of four determinations): Plus or minus 2.0 grams; *Provided*, that the manufacturers shall submit samples of all different sized cartridges, to be considered as part of the original sample, the amount of wrapper to be determined for each size of sample; and, *Provided further*, that the tolerances as suggested shall be made in comparison with the various diameters as submitted with the original sample.

APPARENT SPECIFIC GRAVITY of cartridge, by sand (average of four determinations): plus or minus 7.5 per cent; *Provided*, that actual density shall be determined on cartridges of the same diameter as the standard, and, *Provided further*, that manufacturers shall be required to submit samples of all sizes.

GAS AND DUST, GALLERY NO. 1. No ignition must be obtained in each of one or more trials. *Note:* In the retesting of permissible explosives by tests 1, 3, and 4, the charges of the explosives fired will be reduced 10 per cent in weight from the weights originally used in order to eliminate any likelihood of a failure being due to the natural variations in the gallery conditions.

PENDULUM FRICTION TEST: Each explosive must pass a test of ten trials under the same conditions as originally tested, except that the height of fall of the wood fiber shoe will be reduced by 10 per cent in order to eliminate any likelihood of a failure being due to the natural variations in test conditions.

The following persons were present at the conference: John H. Feeman and Willard Young, Atlas Powder Company, Wilmington, Delaware; G. R. McAbee and C. T. Crone, McAbee Powder & Oil Company, Pittsburgh, Pa.; W. H. Blumenstein, W. H. Blumenstein Chemical Works, Pottsville, Pa.; W. C. Anderson and J. S. Burton, Burton Powder Company, Pittsburgh, Pa.; A. M. Comey, E. I. du Pont de Nemours Powder Company, Wilmington, Delaware; and Herbert Talley, Hercules Powder Company, Wilmington, Delaware. The bureau was represented by Van. H. Manning, Acting Director, Dr. Charles E. Munroe, consulting explosives engineer, George A. Hulett, consulting chemist, S. P. Howell and C. G. Storm, explosives chemists.

THE RISE IN PRICES IN THE GERMAN CELLULOID INDUSTRY

According to the *Berliner Tageblat*, because of the rise in cost of the raw products of the celluloid industry towards the beginning of November, especially of Japanese camphor and Chili saltpeter, the manufacturers were forced to raise their prices considerably. While synthetic camphor offers a substitute for the Japanese article, unfortunately the manufacture of synthetic nitric acid has not progressed to a point where it affords the necessary supply. The celluloid manufacturers were caught entirely unprepared, with the result that they bought up all the available raw products on the market, forcing prices still higher. Although it was known at the outbreak of the war that these raw products would be liable to seizure by the government for the army, exact information on this point was not to be had, and this also affected prices. While some qualities could have stood a slight rise in price, the hundred per cent increase demanded was out of the question for most consumers, and many canceled the orders they had already given. Since celluloid is chiefly used in the manufacture of luxuries rather than necessities, economic conditions also tended to cut down the demand for it. The great falling off in demand must eventually bring down to some extent the price of the raw materials.

ENGLAND'S TRADE IN MAY, 1915

The British Board of Trade report for the month of May shows imports into the British Isles of $358,022,000, against $299,950,000. Exports were $198,090,000, compared with $210,255,000 last year.

The increase in the value of imports was due largely to gains in food, drink, and tobacco, amounting to $40,580,000; cotton, $13,685,000; manufactured iron and steel increased $1,395,000. Other metals and their manufactures increased $8,145,000.

The largest decreases in exports were $11,100,000 in manufactured cotton, $7,780,000 in machinery, $4,490,000 in coal and coke, and $4,210,000 in iron, steel, and the manufactures thereof.

England's imports and exports by months during the past year compare with one year ago as follows:

	Imports		Exports	
	1915	1914	1915	1914
May	£71,604,400	£59,990,000	£39,618,000	£51,421,577
April	73,678,288	61,626,830	42,126,787	50,736,066
Mar.	75,982,845	67,339,845	39,829,000	54,171,870
Feb.	65,265,744	62,050,744	36,405,778	51,490,778
Jan.	67,401,006	68,005,009	35,143,057	57,403,108
	1914	1913	1914	1913
Dec.	67,100,000	71,111,857	36,055,000	53,055,443
Nov.	55,900,918	68,480,918	32,606,807	52,756,807
Oct.	51,562,000	71,732,893	38,158,000	56,178,843
Sept.	45,056,086	61,359,086	33,527,877	49,277,877
Aug.	42,362,034	55,975,704	28,631,104	52,261,228
July	59,383,792	61,783,683	52,231,296	55,475,551
June	58,272,042	58,309,519	48,626,410	51,377,685

AMERICAN STEEL RAILS

The American Iron and Steel Institute reports that the production of steel rails in the United States declined last year to 1,945,095 tons—the smallest production for any year since 1908. The contraction of the output in 1914 as compared with that of 1913 was no less than 1,557,000 tons, or 44 per cent. The yearly production has been as follows during the decade ending with 1914 inclusive:

Year	Tons	Year	Tons
1905	3,375,929	1910	3,634,029
1906	3,977,887	1911	2,822,790
1907	3,633,654	1912	3,327,915
1908	1,921,015	1913	3,502,780
1909	3,023,845	1914	1,945,095

In 1905, Bessemer steel rails were made to the extent of 3,192,347 tons; in 1914 this class was represented by only 323,897 tons. On the other hand, open-hearth steel rails advanced from 183,264 tons in 1905 to 1,525,851 tons in 1914. The causes of the great contraction observable last year in American steel-rail making were due to the reduction of railroad construction and to a curtailment of renewals due to unsatisfactory internal conditions in the United States and to the adverse financial influence, of course, of the great European war. The external demand for American steel rails dwindled to small proportions last year, having amounted to only 174,680 tons, as compared with 460,553 tons in 1913, 446,473 tons in 1912, and 420,874 tons in 1911.

THE RUSSIAN PETROLEUM INDUSTRY

The firm of Nobel Brothers has, according to *Engineering*, 99 (1915), 572, published a budget, for the current year which emphasizes the fact that, on account of the war, very special conditions and factors have to be reckoned with for 1915. On the one hand there will be higher expenses, such as excise, railway freights, and imperial taxation, and, further, necessary materials and plant have very materially risen in price. On the other hand must be considered the further large growth in the use of naphtha for fuel in the neighboring districts, a movement which is likely to continue on an increasing scale on account of the great shortage of coal and of several large railway concerns having decided to adopt naphtha firing in preference to coal. This movement, in its different phases, has been accelerated by the material increase in the production of naphtha in the Baku district, especially from the newly-opened springs. So as to be able to satisfy this growing demand, the company has been endeavoring to increase the stock of naphtha in its Volga tanks, and further purchases will have to be undertaken. The company estimates its sale of naphtha for 1915 at 2,930,800 tons, against 2,567,080 tons for 1914. The bulk of this increase is for liquid fuel. The sale of petroleum is calculated to yield an increase of $721,000. The sale of lubricating oil is likely to decrease, as the war has put a stop to the export. The budget for 1915 balances with $83,945,000, against $61,285,000 for 1914. Quotations at Baku are stated to have risen $0.86 per ton for petroleum and $0.50 per ton for naphtha residues.

ALCOHOL IN GERMANY

At the annual meeting of the Association of German Alcohol Manufacturers, held in Berlin in the last week of February, it was stated that there was a strong demand, at the beginning of the war, for prohibiting the use of potatoes, which were wanted as food, as raw material for alcohol distillation [*Engineering*, 99 (1915), 517]. This is one of the chief resources of the large farmers, especially in the eastern parts of Prussia, where the soil is not suitable for raising much grain. The need of alcohol for chemicals and as substitute for benzol, lamp oil, etc., was too imperative, however, and the actual consumption of alcohol for technical purposes was higher in the last quarter of 1914 than it had been before. The production decreased, however. It was pointed out that a certain consumption of alcohol seemed to be indispensable in the interest of the economy of the industry, as long as the fermentation of the starch in the potato and the distillation could not be conducted in such a way as to yield a product of higher value than alcohol. A certain success has been realized in this respect. In his new works at Arnsdorf, near Frankfort, Böttinger gains one-third of the possible yield in alcohol as acetone. Scientific investigation has been pushed successfully in other directions also. One of the minor sources of waste stopped is that feeding of cattle with raw potatoes has been abandoned, because cattle cannot extract any nutriment from this food, while pigs can. Considerable success has also been realized in the cultivation of waste moorlands.

COKE-BREEZE BRIQUETTES

An article in the *Journal für Gasbeleuchtung*, of the 6th of March, by Mr. Behr, the Manager of the Gas and Water Works at Kolberg, describes experiments made during the past six years on the briquetting of coke breeze, and the plant which, as the result of the experiments, has been installed at the Kolberg gas works for making briquettes.

The utilization of coke breeze in gas works for firing boilers, either with or without admixture with thick tar, necessitates the use of suitable grates, blowers, etc. The flues rapidly get choked, and much unconsumed breeze is lost, owing to the action of the blast. The use of coke breeze in specially constructed suction producers leaves little to be desired as regards economy and complete consumption, but there are not sufficient of these plants to utilize much of the breeze, and in many cases local conditions would preclude their use.

Having regard to these considerations, the author proceeded to study the manufacture of briquettes from coke breeze.

The process which gave the best results was the compression of the breeze after the addition of finely divided hard pitch and heating the mass to 300°–400° C. Experiments with other binders—such as both thin and thick tar, with an addition of sawdust and coal dust—all failed in respect of ease of ignition.

In regard to uses for the briquettes, a small $2^1/_2$ by $2^1/_2$ inch size may be used in all cases where the layer of fuel is not less than 8 to 10 inches. Good chimney draught is obviously desirable—*i. e.*, such as is required for ordinary 2-inch coke. The best results, however, are obtained in closed iron stoves, central heating plants, etc., in which 50 to 100 per cent of the fuel ordinarily used can be replaced by coke briquettes. Like any novelty, it has proved rather difficult to introduce the use of coke briquettes. It is necessary to show a small stove burning the briquettes to convince people that they burn well.

When the coke briquettes were introduced about six years ago they did not give great satisfaction, but these were a larger size, 4 inches diameter, and they were not as hard as the later ones. After the small $2^1/_2$-inch briquettes had been introduced, many householders took kindly to them, and now at times the output does not meet the demand. The result of the introduction of the briquetting plant at Kolberg has been not only to dispose entirely of coke breeze produced on the works, but coke breeze has been bought from other works to work up into briquettes.

CANADIAN RAILWAYS

At the close of June, 1914, the length of railway completed in Canada was 30,795 miles, while 22,891 miles more were under construction, or had been planned [*Engineering*, 99 (1915), 471]. The increase of completed railway in 1913–14 was 1491 miles, in addition to which 309 miles of previously opened line were double-tracked. The capital embarked in completed Canadian railways amounted at the close of June, 1914, to $1,808,320,761; and if securities of lines under construction are taken into account, the aggregate is increased to $1,962,128,070. The gross earnings of Canadian railways in 1913–14 were $243,083,539, showing a decrease of $13,619,150 or $5^1/_2$ per cent as compared with 1912–13. The net earnings declined in 1913–14 to the extent of $10,582,723. Guarantees and subsidies granted by the Dominion Government and sundry provincial bodies amounted at the close of June, 1914, to $406,259,165.

NICKELPLATING OF ALUMINUM

In a communication to the Académie des Sciences, M. Le Chatelier gives particulars of a new process for the nickelplating of aluminum. The aluminum is given a preliminary treatment in a bath of hydrochloric acid containing a certain portion of iron. The iron is precipitated on the surface of the aluminum forming a kind of network. When this is passed into a nickel bath the nickel becomes entangled in this network and adheres strongly to the aluminum. This process is based on a physical action, and appears to solve the problem hitherto considered impossible.—D. G. ANDERSON.

PRODUCTION OF TUNGSTEN AND MOLYBDENUM IN ENGLAND

According to the *Times Engineering Supplement*, **1915**, 486, the outbreak of war found Great Britain very deficient in the supplies of many of the rarer metals employed in steel manufacture, and for a time much anxiety was felt respecting the possibilities of manufacturing in England certain of these metals hitherto obtained in large quantities from the Continent. Among these mention may be made of the compounds of chromium, tungsten and molybdenum.

In the case of tungsten, the best wolfram ores are brought from Portugal and India, while the molybdenite used in the preparation of ferro-molybdenum comes from Norway, Sweden, and Australia. The Australian ores cannot, in the most favorable circumstances, be conveyed from the mines to Britain in less than two months, and as they are extremely costly it would not pay the manufacturer to hold large quantities of ore in reserve.

One factory at Luton, in England, has now extended its plant so that it is capable of turning out nearly 1,000 tons of ferrotungsten and tungsten powder annually, and it is unlikely that the trade in tungsten powder will ever revert to Germany after the war. The process used at the Luton factory for the production of tungsten powder consists in boiling the finely ground wolfram with a soda solution. The tungstate of soda formed is settled in tanks and dried so as to produce coarse crystals. The compound is then treated with hydrochloric acid in wooden vats, by which means the tungstic acid is liberated as a yellow paste. In order to reduce the acid, it is mixed, after thorough drying, with charcoal in large crucibles and heated for 18 hours in a reverberatory furnace. The slaglike mass thus prepared is crushed and ground to a fine powder, which is finally passed through wire sieves with 120 meshes to the inch, and represents tungsten of 98 per cent purity.

In the manufacture of ferrotungsten large 3-ton electric furnaces, each with three suspended electrodes are used. The feeding of the furnaces takes place by hand in small charges of the mixed ore, with the requisite quantity of carbon-fuel, scrap iron and flux. The molten masses of ferrotungsten are drawn off from time to time and after cooling are hand-broken and sorted into various sizes. Owing to the great weight of the material, it is a matter of considerable difficulty to handle it in bulk. It is usually packed in steel casks, each of which contains 25 cwt.—A.

PALM KERNEL CAKE AND MEAL

In a recent issue of the *Bulletin of the Imperial Institute*, it is stated that the chief center of the palm kernel industry was Hamburg, where, until recently, practically all the palm kernels extracted in Africa were shipped. This included very large quantities from British West African possessions, as, for some inexplicable reason, very little crushing of these kernels was done in England. This condition of affairs is likely to be altered in the near future, and as a matter of fact the change has already commenced, the first shipment ever received in Hall, consisting of 1,600 tons of kernels, having arrived, but since then over 100,000 tons of kernels have been imported into Great Britain. Palm kernel oil is very similar in its properties to coconut oil, but has not such a marked taste and odor. It is quite neutral and can be used as an alimentary fat. It is easily saponified and forms a good hard soap, especially suitable for and largely used in the manufacture of dry soaps. The press cake or meal is quite suitable for cattle feeding, and it is well known and largely employed for this purpose in Germany, Holland, and Denmark, but it is practically unknown in England. Experimental feeding trials with this cake have been arranged at several agricultural colleges in England and in view of the fact that the import feeding cakes (linseed, cottonseed, and rapeseed) for the year 1913 totaled 406,700 tons, the results will be of considerable interest.—A.

MARBLE FOR ELECTRIC LIGHT SHADES

It has been found that marble cut into thin sheets, 0.02 in. to 0.1 in. thick, is sufficiently transparent to be used instead of opal glass for electric light shades. The sheets are given a special treatment with oil at a high temperature and pressure, and give beautifully clear effects. Comparing the transparency and diffusive properties of such marble sheets and opal glass, it was found that the amount of light transmitted was approximately the same in both cases, but that the diffusive power of marble was distinctly better.—A.

PRODUCTION OF PLATINUM IN RUSSIA

A Russian correspondent writing to the *Mining Journal*, **1915**, 4159, states that the production of platinum since the outbreak of the war has been on the decrease. The production for the year 1913 was 173,642 ozs., and for the year 1914 was 156,775 ozs., *i. e.*, a decrease of 16,642 ozs.

As soon as the war broke out the market for platinum—which is, of course, chiefly in France and Germany—being temporarily isolated from the producers, the outlook for the latter, especially the smaller ones, was extremely black. The Government, however, soon came to their assistance, offering $15.79 per oz. on platinum ore at an annual rate of interest of 7 per cent. These terms, however, were not good enough for some of the small producers, especially those working on placers by primitive methods. The Government and private banks eventually increased the terms to $21.90 per oz. at the same rate of interest of 7 per cent, half the year's interest being payable in advance. On the aforementioned terms about 46,240 ozs. of platinum have been deposited in the various banks at Ekaterinburg, some of it having been forwarded to their Petrograd agents. The output of platinum during the year 1915 is estimated as between 86,700 and 104,040 ozs. Although there is at present an embargo on the export of platinum, permission can be, and has been, obtained from the Minister of Trade and Commerce in the event of export to friendly countries.

From the month of July, 1915, however, there is to be an export duty on platinum ore which will probably be prohibitive (about 20 per cent) and which will necessitate the construction in Russia of refineries.—A.

TANNING EXTRACT FOR SULFITE LYE

A British Consular report mentions that the Norwegian Farmand states an establishment for utilizing the waste lye from sulfite pulp production is now being built at Embretsfor, near Drammen.

The establishment will be ready to begin work in three months, and it is estimated that the production of tanning extract from the lye will be about 3000 barrels per year. A factory for producing alcohol from the lye is also likely to be erected in the near future and this latter enterprise will be under the control of a Norwegian cellulose mill.—A.

NOTES AND CORRESPONDENCE

THE SEATTLE MEETING OF THE A. C. S. AUGUST 31 TO SEPTEMBER 2

In addition to the announcements made in the last two issues of THIS JOURNAL (pages 545 and 633) several special features should be noted.

I—THE INDUSTRIAL DIVISION will hold two symposiums: One a continuation of the New Orleans symposium, especially devoted to the part the chemist has had in the progress of special lines of chemical industry. Papers will be presented as follows:

IRON AND STEEL.....GEO. W. SARGENT
IRON AND STEEL..... A. S. CUSHMAN
PERFUMERY.....ALOIS VON ISAKOVICS
PERFUMERY.....E. T. BEISER
LEAD.....G. W. THOMPSON
PAINTS AND VARNISHES.....MAXIMILIAN TOCH
PETROLEUM.....DAVID T. DAY
ILLUMINATING GAS.....SIDNEY MASON

A symposium will also be held on "The Distillation of Wood," papers being presented by the following experts:

J. R. WITHROW	MARC DARRIN	BAILEY TREMPER
J. E. TEEPLE	CHAS. H. HERTY	NEWTON CRITUS

II—The convention will spend September 4th in Portland, Oregon, as guests of the Oregon Section.

III—On the evening of September 6th, a complimentary Smoker will be tendered the visiting members at Techu Tavern, in San Francisco.

IV—A special bulletin containing the itinerary and general information concerning the route of the special train from Chicago has been issued by the Passenger Departments of the Chicago & Northwestern Railway and the Great Northern Railway, from their Chicago offices.

C. L. PARSONS, *Secretary*

BOX 505, WASHINGTON, D. C.

EXPOSITION OF CHEMICAL INDUSTRIES

Arrangements for the Exposition of Chemical Industries to be held at Grand Central Palace, New York, the week of September 20th, are progressing very favorably, and over fifty per cent of the entire main floor space has been reserved by manufacturers throughout the country.

There will be many working exhibits that will be unusually interesting and instructive.

Motion pictures of industrial processes will be a feature as will also lectures by men of prominence in the Chemical Industries.

Meetings of the chemical, chemical engineering and engineering societies are being arranged. The meeting of the American Electrochemical Society, New York Section, has been fixed for Tuesday, September 21st.

An Exposition with as many and as diversified interests has never before been held and a record attendance is expected.

For the benefit of all visitors to this Exposition a very elaborate entertainment program is being arranged for by an Entertainment Committee. Arrangements will also be made by a Ladies' Receiving Committee for the entertainment of all visiting ladies.

The Bureau of Foreign and Domestic Commerce at Washington is heartily in sympathy with the exposition and is contemplating an elaborate exhibit in conjunction with eight other Governmental Bureaus. A large section has been reserved to be known as the Canadian Section, in which a collective exhibit will be made by Canadian manufacturers.

By a special Act of Congress all foreign exhibits for this Exposition upon which there shall be a tariff or customs duty, shall be admitted free of payment of such duty, customs, fees or charges, provided same are not sold or disposed of during the Exposition. All such articles when sold or withdrawn for consumption or use in the United States, shall be subject to the duty, if any, imposed upon such articles by the revenue laws in force at the date of withdrawal, and on articles which shall have suffered diminution or deterioration from incidental handling and necessary exposure, the duty, if paid, shall be assessed according to the appraised value at the time of withdrawal for consumption or use.

The Exposition has been organized by Messrs. Nagelvoort and Roth, with offices at the Grand Central Palace, New York, with the coöperation of the International Exposition Company, who have developed many successful expositions in the past.

PRIZES OFFERED BY THE TECHNICAL SECTION OF THE AMERICAN PAPER AND PULP ASSOCIATION

The Technical Section of the American Paper and Pulp Association is anxious to bring about advancements in methods of manufacture of paper and pulp and, with a view of concentrating attention on some of the more important problems before the American paper and pulp manufacturers, it offers a prize of one hundred dollars for the best paper on each subject in the list given below. It is expected to offer similar prizes each year. This competition is subject to the following rules:

1—The authors of the papers presented must be residents of the United States or Canada.

2—The papers are to reach the office of the Secretary of the Section on or before December 31, 1916.

3—Each paper must be typewritten and must not bear the author's name or address. Instead of the author's name the paper shall bear a number or other designating character or word. Accompanying the paper shall be a sealed envelope containing the author's name and address and the number or designating character by which the paper is characterized.

4—Papers presented in this competition must not previously have appeared in print.

5—The determination of the papers winning the prizes shall be made by a committee of three appointed by the chairman of the Technical Section. This committee shall publicly report its findings to the Section at the time of the Annual Meeting next after February 1, 1917.

6—All papers received shall be returned to their authors soon after the announcement of the winning paper.

7—The articles winning the prizes offered shall be published in the Report of the Organization and also in *Paper*, the official journal of the Section.

LIST OF SUBJECTS

I—The various causes for the deterioration of the Fourdrinier wires and steps to be taken in the prolongation of the life of the wires.

II—How can the pitch in sulfite pulp be eliminated?

III—The effect of the order and time of adding alum, rosin and color on the retention of color.

IV—The retention of the various mineral fillers used in papermaking and their effect on the life of the machine, clotting and the quality of the paper.

PROGRESS OF BUREAU OF MINES RADIUM WORK

Secretary of the Interior Franklin K. Lane announced on July 27th that the production of radium from Colorado carnotite ores by the Bureau of Mines, in connection with the National Radium Institute, has passed the experimental stage in its new

process and is now on a successful manufacturing basis. He also declared that the statements made to congress concerning the ability of the Bureau of Mines to produce radium at a greatly decreased cost over other processes had actually been accomplished and that the costs were even less than predicted.

"The cost of one gram of radium metal produced in the form of bromide during March, April and May of the present year was $36,050, I am informed by Dr. Charles L. Parsons, in charge of the radium investigations of the bureau. This includes the cost of ore, insurance, repairs, amortization allowance for plant and equipment, cost of Bureau of Mines coöperation, and all expenses incident to the production of high-grade radium bromide. When you consider that radium has been selling for $120,000 and $160,000 a gram, you will see just what the Bureau of Mines has accomplished along these lines."

"The cost of producing radium in the small experimental plant during the first few months of the Bureau's activities was somewhat higher but not enough to seriously affect the final average."

"The public, however, should not infer that this low cost of production necessarily means an immediate drop in the selling price of radium. The National Radium Institute was fortunate in securing through the Crucible Steel Company the right to mine ten claims of carnotite ores belonging to them and this was practically the only ore available at the time. Since then new deposits have been opened but these are closely held and, according to the best judgment of the experts employed by the Bureau of Mines, the Colorado and Utah fields, which are much richer in radium-bearing ores than any others known, will supply ore for a few years only at the rate of production that obtained when the European war closed down the mines. The demand for radium will also increase rapidly, for the two or three surgeons who have a sufficient amount of this element to entitle them to speak from experience are obtaining results in the cure of cancer that are increasingly encouraging as their knowledge of its application improves. A few more reports like that presented to the American Medical Association at its recent San Francisco meeting and the medical profession as a whole will be convinced of its efficacy. Under all the circumstances that have come to my knowledge it does seem to me that it behooves the Government to make some arrangement whereby these deposits, so unique in their extent and their richness, may be conserved in the truest sense for our people, by extracting the radium from the ores where it now lies useless and putting it to work for the eradication of cancer in the hospitals of the Army and Navy and the Public Health Service."

"The ten carnotite claims being operated at Long Park, Colorado, by the National Radium Institute have already produced over 796 tons of ore averaging above two per cent uranium oxide. The cost of ore delivered at the radium plant in Denver has averaged $81.30 per ton. This included 15 per cent royalty, salary of Bureau of Mines employes, amortization of camp and equipment and all expenses incident to the mining, transportation, grinding and sampling of the ore."

"A concentrating plant for low-grade ores has been erected at the mines and is successfully recovering material formerly wasted. Grinding and sampling machinery has been installed at Denver and a radium extraction plant erected in the same city. The radium plant has now a capacity of three tons of ore per day, having been more than doubled in size since last February. Before that time the plant had been run more or less on an experimental scale although regularly producing radium since June, 1914. To July 1st, slightly over three grams of radium metal had been obtained in the form of radium barium sulfate containing over one milligram of radium to the kilogram of sulfates. The conversion of the sulfates into chlorides and the purification of the radium therefrom is easily accomplished and with very small loss of material. Unfortunately, however, special acid proof enamel ware, obtainable only in France, has not been delivered of sufficient capacity to handle the crystallization of the full plant production, so that a little less than half the output, or to be exact, 1304 milligrams of radium element have been delivered to the two hospitals connected with the National Radium Institute. The radium remaining can be crystallized at any time from neutral solution in apparatus already installed, but the greater rapidity and efficiency of production of this very valuable material by the methods used have decided the Bureau of Mines to await the completion of apparatus now being built before pushing the chloride crystallization to full capacity."

"The average radium extraction of all ore mined by the National Radium Institute has been over 85 per cent of the amount present in the ore as determined by actual measurement. The amount present in the ore has been found in fact to be essentially the same as the theoretical amount required by the uranium-radium ratio. The extraction figures for the last five carloads of carnotite treated have shown a recovery of over 90 per cent in each case."

"A bulletin giving details of mining, concentration and methods of extraction is being prepared by the Bureau of Mines and will be issued early in the fall."

NOTES ON THE GALACTAN DETERMINATION

In the course of an extended investigation of the Pacific Coast kelps recently carried out in this laboratory,[1] it became desirable to determine the galactan in a number of the dried samples. On attempting to apply the provisional method as given in *Bull.* **107**, Bureau of Chemistry, it was found impossible to obtain satisfactory results. Efforts were then made to make this method workable but no success can be reported in that direction. It is the aim of this paper to point out several faults in the present method and to emphasize the necessity of improving it by more systematic study of the reaction upon which it depends.

Briefly stated, the method consists in evaporating a weighed portion of the material with dilute nitric acid whereby the galactans are converted into mucic acid. Under the prescribed conditions the mucic acid crystallizes out, together with organic impurities. To remove the latter, the residue is extracted with ammonium carbonate solution, dissolving the mucic acid as ammonium mucate. The filtered solution is decomposed by nitric acid, causing the mucic acid to again crystallize out, after which it is filtered, dried and weighed on a tared Gooch crucible.

On following out the directions of the provisional method the difficulty already noted by Lindsey[2] was encountered that the final residue often appeared to be not mucic acid at all but organic decomposition products incidental to the reaction. Some improvement was obtained by following the plan recently proposed by Miyake[3] in which the material was filtered immediately after evaporation and washed thoroughly with hot water thus retaining the mucic acid in solution. The filtrate was then evaporated to one-third of the volume of the nitric acid taken and the crystallization allowed to proceed as usual. It was found that the large amount of mineral salts present in the sea-weeds prevented crystallization of the mucic acid in some cases. Accordingly, the further modification was introduced of leaching the sea-weeds with cold water to a filtrate volume of 50 cc., thus removing most of the salts. The extracted residue was then oxidized according to Miyake's method.

Even with these improvements no crystallization of mucic

[1] J. S. Burd, *Bull.* **248**, Cal. Agr. Exp. Sta. and D. R. Hoagland, Journal of Agricultural Research **4**, p. 39.

[2] Lindsey, 14th Convention A. O. A. C., *Bull.* **51**, p. 94.

[3] Miyake, *Chem. Abs.*, **6**, 2958, October 20, 1912

acid was obtained from samples which we were satisfied contained galactans. This led to a series of experiments in which varying amounts of galactan and milk sugar were treated in the usual manner.

It was found that the percentage yield of mucic acid on the galactose taken varied greatly with the amount taken. (This fact has been recently reported by Miyake[1] but was discovered independently by the author.) When 2 grams of galactose were taken, the amount of galactose recovered, as calculated by multiplying the weight of mucic acid by the official factor (1.33), was 90 per cent. When 0.2 gram of galactose was taken 54–74 per cent of galactose was recovered. When 0.1 gram was taken, in one case 37 per cent of galactose was recovered and in a duplicate determination no mucic acid crystallized out. Smaller quantities of galactose failed to yield any mucic acid.

Browne[2] has pointed out that theoretically 180 parts of galactose produce 210 of mucic acid—a yield of $116^2/_3$ per cent. The oxidation of galactose to mucic acid has been generally accepted as following in practice the yield of 75 per cent on the galactose. This figure is the result of the work of Tollens[3] and his associates and was based on experiments in which he oxidized milk sugar and galactose in quantities of 1.25 to 5 grams. There is no record of experiments on small quantities of galactose and it has been assumed that the same factor holds for all amounts. The results obtained in this laboratory indicate that the usually accepted factor does not apply at all to any but large percentages of galactose and that when the quantity becomes small (2–3 per cent) the method may fail to yield any mucic acid whatever and at best will give results far below the truth.

There appears to be no relief from this source of error in the determination until the reaction upon which it depends is better understood. Evidently the changes taking place cannot be described by a single simple equation, but must take into account one or more secondary products. Further study of this reaction might result in controlling the formation of the undesirable compounds and thus make the method workable.

W. H. DORE

DIVISION OF AGRICULTURAL CHEMISTRY
UNIVERSITY OF CALIFORNIA EXPERIMENT STATION
BERKELEY, February 1, 1915

NOTE ON STARCH-FORMING ENZYME FROM MALT

Editor of the Journal of Industrial and Engineering Chemistry:

In the February number of THIS JOURNAL, p. 115, an article appeared by Charles B. Davis entitled "On a Starch-forming Enzyme from Malt: Its Action on Hemi-cellulose and Its Commercial Application to Brewing." We have carefully repeated the experimental work in this article and were unable to confirm any of it as far as the enzyme "hemi-cellutase" is concerned, or to verify any of the conclusions of the author. We repeated the experiments outlined on page 118, preparing Solution "A" exactly as described in this article, and using various samples of starch, like rice and potato-starch, but in no case were we able to obtain a blue reaction due to starch, although we tested both the solution and the *residue* very carefully with dilute iodine solution, checking the latter against very dilute solutions of starch. We also repeated the experimental work outlined in the last two paragraphs of the article, using four different types of malt separately, and each one of these malts again with grits or flakes, but in no case were we able to obtain the blue reaction mentioned by Mr. Davis.

In footnote (*b*) to Table IV it is stated that "when the hemi-cellulose is finely divided, the reaction takes place at 10 to 20° C." This latter statement is contrary to all our accepted ideas about enzymes. If an enzyme has an optimum temperature of 82.5° C. we certainly would not expect that a mere subdivision of the substrate should reduce its optimum temperature over 60°, that is, from 82.5° C. to 10 to 20° C. However, to check this point we tried the effects of coarse and fine grinding on the samples of malt mentioned above, but in no case could we obtain the starch reaction at 82.5° C.

In conclusion I would say that we were unable to confirm any of the experimental work in this article and could obtain no evidence of the presence of an enzyme which would decompose hemi-cellulose at 82.5° C. In my opinion the entire article is erroneous.

SIDNEY BORN

WM. J. LEMP BREWING COMPANY
ST. LOUIS, June 18, 1915

[1] Miyake, *Chem. Abs.*, **8**, 2007, June 10, 1914.

[2] Browne, "Handbook of Sugar Analysis," 1st ed., p. 459.

[3] Tollens and Creydt, *Ann.*, 227–231; Tollens and Rischbiet, *Ber.*, **18** (1885), 2616; Tollens, Kent, Rischbiet and Creydt, *Landw. Vers. Sta.*, **39**, 401.

COLUMBIA UNIVERSITY ESTABLISHES A SEPARATE DEPARTMENT OF CHEMICAL ENGINEERING

Courses leading to the degree of Chemical Engineer have been offered in the Department of Chemistry of Columbia University for the past ten years, but, in recognition of the rapidly increasing importance of those industries based upon the applications of chemistry and the consequent demand for men specially trained in the fundamental engineering practices as applied to the problems of industrial chemistry, the Trustees of Columbia University have established a separate Department of Chemical Engineering upon the same plane of importance in the Columbia Graduate Engineering School as Mining, Civil, Electrical and Mechanical Engineering.

The demand for graduates to fill important positions in the rapidly developing industries of the United States has brought an ever-increasing number of students to study Chemical Engineering at Columbia, the registration in this subject having reached a total of eighty-one during the past year.

The new chemical engineering laboratories, which were recently installed, where the students are taught to use engineering methods and engineering appliances in the study and development of chemical industry, will be provided with still further equipment during the present summer. These laboratories are equipped with apparatus to illustrate the various fundamental operations of chemical and electrochemical processes, and the student learns by actual contact to apply fundamental scientific principles to industrial problems. Here research may be conducted on such a scale as to establish the dependable engineering data necessary for intelligent and accurate process design.

The sudden demand for products previously secured from Europe has greatly stimulated activity among chemical manufacturers. In many cases it is necessary first to develop the raw material supplies, as for example for th manufacture of coal-tar dyes, where large quantities of benzol, phenol, toluol, etc., are required. The demand for these materials is being met rapidly by the installation of large plants for the recovery from coke oven gases of these heretofore waste products. Such concerns as the Lackawanna Steel Co., United States Steel Co. and other large coke producers both in the United States and Canada are now recovering these products. Similar activity obtains in other fields; for example, on account of large demands for explosives, the production of sulfuric and nitric acids is being enormously increased.

Entirely aside from these abnormal developments, forced upon us by the war, it should be noted that chemical processes are being established in other fields. For instance, within the last month two enormous installations, one at the Anaconda Smelter and another at Chuquicamata, Chile, have been started for the extraction of copper by chemical methods. Plants for the production of sulfuric acid as a by-product from the roasting of sulfide ores along the lines of the plant at Ducktown, Tenn., have also been established at Langloth, Pa., Cleveland, Ohio, and by the United States Steel Corporation.

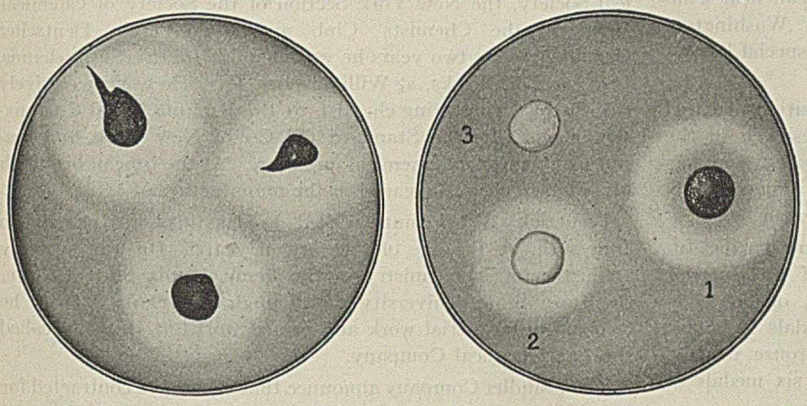
POSSIBLE STERILIZING PROPERTIES OF DENTAL CEMENTS

Editor of the Journal of Industrial and Engineering Chemistry:

In THIS JOURNAL, March, 1915, appeared an article by Paul Poetschke, entitled "The Germicidal Efficiency of Dental Cements." The concluding paragraph promised reports on the comparative strength and other properties. These reports would be, as Mr. Poetschke states, "of more immediate interest to the dental profession" and it will be by clinical experience in the hands of the dentist that this subject will receive its final analysis and probably be reported mainly in the dental literature.

Since Mr. Poetschke very pointedly refers to and criticizes my paper entitled "Possible Sterilizing Properties of Filling Materials," published in the *Dental Review*, June, 1914, it may be of interest "to chemists and bacteriologists" to have reproduced in THIS JOURNAL the one illustration criticized by Mr. Poetschke, the criticism being mostly that only comparative inhibition has been shown and that there had been no bacterial count.

In my paper under criticism there is the statement: "Subjection of hardened pellets to media has been of interest, but it is by the application of freshly mixed cement to inoculated agar that we closely duplicate the placing of cement into a tooth cavity." This referred to a cavity from which all infected material had not been removed, there being, for this reason, a need of a sterilizing filling. It is well known by the dental profession that a real copper oxid cement will furnish the means of sterilization of such an infected area, and yet furnish a mass, after proper setting, which is so highly insoluble that it would only show potency *in the hardened state* equal to the best of the so-called copper cements tested by Mr. Poetschke, including that made by the L. D. Caulk Company, the employers of Mr. Poetschke. The question of whether the testing of cements in the freshly mixed or the hardened state has most clinical significance is being logically considered by all interested.



In some attempts by the author, looking to an improvement of the integrity of dental cements, and an imparting of sterilizing properties thereto, the incorporation of precipitated copper with so-called oxyphosphates of zinc available, was one of the means employed.

In this employment of precipitated copper, it was incidentally observed that the film of oxid on the surface of the particles tended to make cement when the precipitate was mixed with an acid phosphate solution. This seems to have been the first suggestion of the cement-making power of the copper oxids.

Before dental societies and in the dental literature as early as 1894, attention was called to the cement-making property of the cuprous and cupric oxids, and the statement was then offered that the cupric furnished the better cement, all properties considered. There has been much clinical advantage taken of the germicidal efficiency of the combination and there has naturally been a general desire that an equally efficient material might exist of a color not limiting its use.

The difference in germicidal efficiency between a real copper oxid cement and an oxyphosphate of zinc cement, more or less modified by a copper compound, each in a freshly mixed state, is so great that results may be shown which appeal to the naked eye instead of needing microscopical count. For this reason in the presentation of the paper referred to, many such results were shown.

In the illustration here shown, the inoculation of the agar was such as would be termed overwhelming in testing hardened pellets. With this inoculation there would need to be extreme dilution to enable a count.

Fig. I shows the consistent inhibition by a real copper oxid cement. On the agar of the Petri dish No. 2 was placed mixture No. 1, a real copper oxid cement, No. 2, a zinc oxid cement carrying a small percentage of oxid of mercury (yellow), and No. 3, a pellet of the "white copper" cement manufactured by Mr. Poetschke's employers. Whether this method carries proper clinical significance, is, as we have said, being logically considered by those most intimately interested.

THE W. V.-B. AMES COMPANY
CHICAGO, July 9, 1915 W. V-B. AMES

NOTES ON THE DETERMINATION OF HYDROCARBONS AND HYDROGEN IN GAS

Editor of the Journal of Industrial and Engineering Chemistry:

Every one who has determined the hydrocarbons in gases by combustion knows how irritating it is when the platinum spiral becomes overheated during combustion and melts, thus spoiling the analysis. If the combustion pipette contains three electric leads instead of two, there can be two different circuits with two different platinum spirals, so that, if one should be melted, it would be merely necessary to turn the current through the other, and thus the sample can be saved, and the determination finished. This has saved many a determination for me.

When hydrogen is determined by the Palladiumized Asbestos Method, trouble is often encountered owing to a film of liquid passing into the capillary tube, moistening the palladium and destroying its power of catalyzing the oxidation of hydrogen. If near each end of the palladium tube a small enlargement is blown, the films of liquid will be stopped, and the palladium will not become wet. Since using the palladium tube enlarged in this way, all of my troubles, due to the palladium becoming "poisoned," have ceased.

OHIO STATE UNIVERSITY
COLUMBUS, April 21, 1915 D. J. DEMOREST

NOTE ON THE DETERMINATION OF FAT IN MOLASSES FEEDING STUFFS

When making fat determinations on molasses feeding stuffs (the ordinary feeds mixed with molasses) the writer has found that the official method gives low results, as the molasses covering the grains prevents thorough action of the ether. The method now followed for this class of feeds is to extract with ether as usual, drive off the ether from the thimble and suspend the thimble in a liter of water to dissolve out molasses, using two portions of water. The thimble and their contents are then dried and re-extracted with ether which now takes out all the fat.

Extraction	I	II (after removing molasses)
Sample No. 1	0.91 per cent fat	2.90 per cent fat
Sample No. 2	0.60 per cent fat	2.24 per cent fat

Maximum differences are shown above; the determinations were made on two samples which contained a large percentage of molasses.

PAUL-GALE-GREENWOOD BUILDING
NORFOLK, VIRGINIA, May 1, 1915 E. O. THOMAS

PERSONAL NOTES

Dr. Clifford Richardson, of New York, was elected *President* of the Association of Harvard Chemists at the fourth annual dinner, held recently at Young's Hotel, Boston. Other officers are: *Vice-Presidents*, Professor W. D. Bancroft, of Cornell University, and Dr. F. W. Clark, of Washington; *Secretary and Treasurer*, Professor S. B. Forbes.

Prof. S. C. Lind has resigned the chair of general and physical chemistry in the University of Michigan. He has already been absent from the university for two years on leave as a member of the Denver U. S. Bureau of Mines Experiment Station, where he will continue his work on radium.

The Pittsburgh Section of the A. C. S. has recently issued a 32-page pamphlet containing its history, its by-laws and membership directory. The directory includes the full name, home address, position and specialty of each individual.

Prof. Charles Lee Crandall, of the college of civil engineering, Cornell University, has retired from the faculty after a service of forty-two years, and has been elected a professor emeritus.

The Bureau of Standards has completed the plans for its new chemical laboratory building, the cost not to exceed $200,000, for which appropriation was made by congress last winter. The laboratory will be situated on Pierce Mill Road near Connecticut Avenue, in the northwest suburbs of Washington, D. C., and will form the seventh of the group of special laboratory buildings erected for the bureau.

Prévost Hubbard has recently accepted the position of Chief of the Division of Road Material Tests and Research in the U. S. Office of Public Roads and Rural Engineering, and has resigned as Chemical Engineer in charge of the division of Roads and Pavements of the Institute of Industrial Research.

The preliminary list of awards by the Panama-Pacific International Exposition gives the Department of the Interior collective exhibit one grand prize. The exhibit of the Geological Survey receives one grand prize, four medals of honor, five gold medals, six silver medals, and two bronze medals. The Bureau of Mines receives one grand prize, six medals of honor, three gold medals, and three silver medals.

The Trustees of the Colorado School of Mines announce the election of Dr. W. B. Phillips as President of that institution.

Dr. Arthur A. Noyes, of the Massachusetts Institute of Technology, is to become a member of the faculty of the Throop College of Technology, Pasadena, Cal., for a portion of the coming academic year, and for one-half of the time in succeeding years, beginning with 1916–1917. This arrangement has been made possible by a gift of $10,000 for the equipment of a physical chemistry laboratory, and the endowment of this laboratory in a sum yielding $10,000 annually for its support. This laboratory is to be located in a new chemistry building, which is expected to be built during the coming academic year.

Arrangements for an exchange of professors between the University of Washington and the University of the Philippines have progressed to the stage where it is probable that Dr. Horace G. Byers, professor of chemistry in the University of Washington, will spend the next year in Manila. In the event of his going, Prof. Horace G. Deming, a graduate of the University of Washington, head of the department of chemistry in the University of the Philippines, will go to the University of Washington for the year.

Gail Mersereau died at his home in Cayuga, N. Y., on Wednesday, July 14th, of cerebral meningitis, superinduced by poisoning by noxious gases. Mr. Mersereau was a graduate of Columbia University, in the class of 1903, member of the American Chemical Society, the New York Section of the Society of Chemical Industry, the Chemists' Club and the Verein Deutscher Chemiker. For two years he was chemist to the Susquehanna Dye and Silk Works, at Williamsport, Pa. He was successively silk chemist, consulting chemist to the Panama Canal Commission, chemist for the Standard Oil Co. of New York, and consulting chemist and chemical engineer. At the time of his death Mr. Mersereau was engaged in the manufacture of explosives.

Frederick W. Spanutius died in Hastings-on-Hudson, on June 20th, at the age of forty-seven years. He was formerly an instructor in chemistry in the Pennsylvania State College, the Iowa State University and Lehigh University. Later he engaged in industrial work and owned works at Hastings called the Pan Chemical Company.

The Pfaudler Company announce that they have contracted for space No. 93 for an exhibit of their equipment at the National Exposition of Chemical Industries to be held at the Grand Central Palace, New York City, during the week of September 20th.

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. Consular 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 Consular Reports mailed daily is $2.50 per year, payable in advance, to the Superintendent of Documents.

SUPERINTENDENT OF DOCUMENTS

Publications on Animal Industry. Price List 38, 6th Edition. 36 pp. This is a list of the United States Public Documents relating to various phases of animal husbandry, including poultry and dairy industries, which are for sale by the Superintendent of Documents.

Health, Disease, and Sanitation. Price List 51, 6th Edition. 58 pp. A list of the Government publications which are for sale by the Superintendent of Documents.

BUREAU OF MINES

The Radium-Uranium Ratio in Carnotites. S. C. Lind and C. F. Whittemore. Technical Paper 88. 28 pp. Paper, 5 cents. This is a report on an investigation of the physical and chemical properties of certain carnotites with a discussion of the radium-uranium ratio as determined by various methods. The problem is discussed in its theoretical aspects and the practical application of the ratio as affecting the basis of purchase and sale of carnotites is pointed out. It is stated that "Radium may be easily determined in one operation by the emanation method, either by solution or by ignition from tubes in which it has been sealed for one month to reach equilibrium.

"In contrast with the success of the solution and the ignition methods for de-emanating carnotite, the method of fusion with sodium and potassium carbonates and the fusion-and-solution method both gave low results and were abandoned."

These conclusions are drawn from the analyses of twenty-four lots of the ore from which an average ratio was found identical with that of pitchblende (3.33×10^{-7}). The range in value was from 2.48 to 4.6×10^{-7}.

UNITED STATES NATIONAL MUSEUM

The Fisher, Polk County, Minnesota, Meteorite. GEORGE P. MERRILL. Reprint No. 2084. From the Proceedings of the Museum, 48 (1915), 503–6. This gives detailed description with analyses of the portion of the meteorite which is owned by the Museum and the portion owned by the University of Minnesota.

BUREAU OF FOREIGN AND DOMESTIC COMMERCE

Some Aspects of the Iron and Steel Industry in Europe. Special Consular Report No. 71. 48 pp. Paper, 5 cents. This is a compilation of Consular correspondence on the subject covering the questions of interest regarding the industry in France, Germany, Italy, Switzerland, Sweden and Great Britain. The production data which are of greatest interest are as follows: "The total production (French) of finished iron goods during that year was 524,907 metric tons of 2,204.6 pounds, to which the Paris district contributed 16,311 metric tons, made entirely from scrap iron. The production of finished steel products in the same year reached 3,250,278 metric tons, of which only 111,871 metric tons were made in this district.

"A detailed list of iron and steel products manufactured in 1912 in the Paris district is given below, in metric tons of 2,204.6 pounds each: Iron—merchant iron, 10,492 tons; beams and structural shapes, 4,867 tons; forgings, 82 tons; metal tires, 870 tons; total, 16,311 tons. Steel—merchant steel, 36,957 tons; beams, 12,288 tons; sheets and plates, 28,093 tons; castings, 125 tons; tin plate, 3,694 tons; structural shapes other than beams, 3,134 tons; wire, 23,300 tons; forgings, 4,280 tons; total, 111,871 tons." . . . . . .

"The production of iron and steel in the whole of Sweden in 1912, according to the statistics of the Swedish Government, amounted to 699,816 metric tons of pig iron and cast goods direct from blast furnaces, valued at $14,308,213; 664,141 metric tons of blooms and rough bars; Bessemer and Martin ingots, scrapped and cast goods, valued at $19,677,099; 3,979 metric tons of 'iron sponge,' valued at $65,049; 425 metric tons of blister steel, valued at $29,753; and 509,224 metric tons of 'certain manufactures of iron and steel,' such as bars, wire rods, nails, etc., valued at $21,558,749.

"The exports of iron and steel from Sweden in 1912 were valued at $10,812,500, and of manufactures of iron and steel at $13,129,623. The imports of iron and steel were valued at $4,040,000, and of manufactures of iron and steel at $7,492,300; a total of $11,532,300."

"The largest importers of Swedish iron are Germany and Great Britain. The declared exports of iron and steel from this consular district (Goteborg) to the United States, according to invoices certified at this consulate in 1913, amounted to $520,235, including the following items: Bars and bundles, $159,592; blooms, $115,660; ferrosilicon, $20,286; pig iron, $12,133; steel and iron strips, $157,294; wire rods, $54,865; other kinds, $414.

"Charcoal is used as fuel in the manufacture of Swedish iron and steel, as Sweden does not produce sufficient coke, and it would not be economical to import it for that purpose. Sweden can compete for the world market by producing iron and steel of high quality."

"Despite Sweden's heavy production and exportation of iron and steel, the importation of iron, steel, and certain products of iron and steel amounted in 1912, the last year for which complete statistics are available, to $11,532,400. While the imports of most of the items are very small and may be regarded as mere incidents in the trade, the demand for certain forms of iron and steel from abroad is regular, and, it appears, of sufficient importance to be of interest to American exporters."

The more important items in the list of iron and steel imports for 1912, and the countries from which they were imported, are also listed.

BUREAU OF STANDARDS

The Emissivity of Metals and Oxides. IV. Iron Ore. GEORGE K. BURGESS AND PAUL D. FOOTE. Scientific paper 249. 7 pp. "The present paper is a continuation of the study of the radiometric properties of metals and oxides. The experimental methods and bibliography of the subject have been given in the preceding three numbers of the series.

"The object of this investigation has been the determination of the monochromatic emissivity for a wave length $\lambda = 0.65\ \mu$ and the total emissivity of the oxide of iron formed by heating iron in air."

Electrical Measuring Instruments. Circular No. 20. 2nd Edition. 57 pp. "The object of this circular is to present briefly the fundamental principles underlying the construction and operation of commercial electrical measuring instruments, together with such information concerning the advantages and limitations of the various types of instruments as will assist the user in the determination of the general type best suited to a given purpose.

"The question of sources of error has been treated in some detail, with a threefold purpose: First, to suggest how some errors may be avoided; second, how corrections may be made for known sources of error; and third, to furnish suggestions which will assist those who have to specify instrument performance or to select instruments."

The discussion includes direct current and alternating current ammeters, voltmeters, wattmeters, ampere-hour and watt-hour meters, recording electrical instruments, instrument transformers, and other apparatus of similar character.

UNITED STATES GEOLOGICAL SURVEY

Geology and Coal Resources of North Park, Colorado. A. L. BEEKLY. Bulletin 596. 118 pp. The greater part of this report is of geologic and mineralogic interest only, but there are included sections on the mineral resources, particularly the coal deposits, the ores of copper, gold, and silver and the gilsonite deposits of the districts.

Geology and Ore Deposits of Copper Mountain and Kasaan Peninsula, Alaska. C. W. WRIGHT. Professional Paper 87. 110 pp. and 22 plates. "A detailed description of the geology of the two most important copper-bearing areas in southwestern Alaska, prefaced by a general account of the geology of the Ketchikan district, within which these areas lie. The mining development is only briefly discussed, because it is not of permanent interest and is fully treated in the Survey's annual bulletins showing the progress of investigations of mineral resources in Alaska. The genesis and occurrence of the copper ores are discussed, and special attention is paid to contact deposits, which are well exemplified in this region. The illustrations include a geologic map of the Ketchikan district, topographic and geologic map of Copper Mountain and Kasaan Peninsula, plans and sections of mines, and halftone views of rocks and minerals from the areas discussed."

Shorter Contributions to General Geology, 1914. DAVID WHITE, and Others. Professional Paper 90. 199 pp. and 7 plates. Paper, 50 cents. The separate articles of particular interest have already been reviewed in THIS JOURNAL.

Contributions to Economic Geology. Part I. Metals and Nonmetals Except Fuels. F. L. RANSOME, HOYT S. GALE, and Others. Bulletin 580. 462 pp. Paper, 40 cents. The combined report, separate parts of which have already been reviewed in THIS JOURNAL.

Some Mining Districts in Northeastern California and Northwestern Nevada. J. M. HILL. Bulletin 594. 200 pp. and 19 plates. "A general outline of the geology of a part of northern California and northwestern Nevada, with a brief statement of the nature and occurrence of the ore deposits as a whole and

detailed descriptions of individual mining districts. In these descriptions the following points concerning the districts are considered: Location, accessibility, history, production, climate and vegetation, topography, geology, type and origin of the ore deposits, and origin and character of the veins. Sketch maps of the districts, structure sections of the mountain ranges, and halftone plates showing geologic features make up the illustrations."

Mineral Deposits of Santa Rita and Patagonia Mountains, Arizona. FRANK C. SCHRADER AND JAMES M. HILL. Bulletin 582. 370 pp. The geographic, climatic and physiographic conditions of the district are discussed and detailed information is given of the geography of these ranges. The building materials available are described and the coal and lignite deposits indicated. It is believed that the onyx deposits "are too calcareous to be of commercial value." It is also doubtful whether the deposits of opal will prove commercially worth development. Several pages are devoted to the discussion of the alunite deposits of the district and the water resources.

The Production of Chromic Iron Ore in 1914. J. S. DILLER. Separate Mineral Resources of the United States, 1914. Part I. 15 pp. "The increased marketed production of chromic iron ore in 1914 is noteworthy. The output sold was 591 long tons in 1914, valued at $8,715, as compared with 255 long tons in 1913, valued at $2,854, a gain in 1914 of nearly 132 per cent in quantity and of more than 205 per cent in value. The great increase in value in 1914 was due in part to the rise in price per ton.

"Almost the entire annual output has come from Shasta County, California."

"The large supplies of foreign chromic iron ore permit its delivery in American ports at low rates. It is sold on the basis of 50 per cent content of chromic oxide, and a fair price prior to 1914 for cargo purchases was from $14.50 to $15.50 a ton. Chromic oxide in excess of 50 per cent is sold at the rate of 50 to 60 cents per additional unit.

"In California the price is said to vary from $10 to $17 a long ton, with recent quotations at $15 a ton f. o. b. at shipping point. The average price per long ton of the marketed production of the United States in 1913 was $11.19, but in 1914 the average selling price increased to $14.75. Under this average price is included also the chrome sand of Baltimore, which is used abroad for making special colors and which commands a higher price than any other chromic iron ore because of its cost of production.

"The price of the chromate and bichromate of potash imported in 1913 averaged 8.1 cents a pound and that of chromic acid 14.9 cents a pound. Early in 1915 American manufacturers quoted bichromate of potash at 15–15¼ cents a pound and bichromate of soda 4¾–5½ cents a pound. The restrictions on the importation of chrome ore has not yet materially affected the price of bichromates, but it may be expected to do so if long continued. The abnormally high price of bichromate of potash is due to the great advance in the price of muriate of potash. Chromate of soda is quoted at 6 cents a pound.

"The market price of chrome brick, standard sizes, in carload lots, January 1, 1914, was, on the Atlantic seaboard, $135 a thousand; but at the close of the year the price had greatly advanced on account of the difficulty in importing the chromic ore necessary for the manufacture of the brick."

"In 1914 the imports of chromic iron ore amounted to 80,736 long tons, valued at $695,645, an increase of 15,556 tons in quantity and of $72,824 in value. The imports of chromic acid and of chromates were much greater in quantity and value than in 1913, notwithstanding the restrictions on exports of chromite from Rhodesia, New Caledonia, and some other foreign sources."

The means and uses of chromite and chromic ore deposits of North America are described. There is also included a number of new analyses of chromic iron ores from different districts in this country.

The Recovery of Secondary Metals in 1914. J. P. DUNLOP. Separate from Mineral Resources of the U. S., 1914. Part I. 9 pp. There is included a general discussion of the scope and character of the industry devoted to the recovery of secondary metals from scrap, sweepings, skimmings, and dross. The standard classification for old metals which was adopted by the National Association of Waste Metal Dealers and which took effect January 2, 1915, is reprinted. This indicates the specifications which must be met by waste metals in order to classify in the different grades. The following table shows the recovery of secondary metals in the United States in 1914:

Metals	Quantity Short tons	Value
Secondary copper, including that in alloys other than brass	58,556	$15,435,362
Remelted brass	99,038	21,054,300
Secondary lead	29,337	4,762,836
Recovered lead in alloys	31,725	
Secondary spelter	42,969	4,782,066
Secondary zinc in alloys other than brass	3,914	
Secondary tin	4,535	8,887,158
Recovered tin in alloys	7,912	
Secondary antimony	1	444,844
Recovered antimony in alloys	2,645	
Secondary aluminum	2,791	1,673,140
Recovered aluminum in alloys	1,731	
TOTAL		$57,039,706

Potash Salts, 1914. W. C. PHALEN. Separate from Mineral Resources of the United States, 1914. Part II. 25 pp. The importance of the potash industry to the soap, match, glass-making, photographic, pharmaceutical and general chemical industries makes this report of particular value to many chemists. The following tables include the most important data given in the report:

POTASH SALTS IMPORTED FOR CONSUMPTION INTO THE UNITED STATES, IN POUNDS

POTASH	1913 Quantity	1913 Value	1914 Quantity	1914 Value	Fourth quarter, 1914 Quantity	Fourth quarter, 1914 Value
Carbonate of crude	9,715,878	$272,973	9,326,899	$265,158	2,018,452	$67,821
Caustic, including refined	8,648,753	342,056	7,284,176	285,739	2,052,432	89,510
Cyanide of	1,470,987	216,844	417,139	59,278	71,158	10,602
Chloride of	475,261,595	7,075,745	371,521,920	5,745,385	32,374,720	527,206
Nitrate of saltpeter, crude	9,652,366	261,078	2,230,528	74,869	.....	.....
Sulfate of	88,698,193	1,677,429	80,447,360	1,557,224	10,053,120	208,890
All other	19,067,144	959,595	14,590,437	756,320	2,339,009	148,896
TOTAL	612,514,916	10,805,720	485,818,459	8,743,973	48,908,891	1,052,925

NOTE—The data for the Fourth Quarter of 1914 show the marked influence of the war.

IMPORTS OF POTASH SALTS IN THE MONTH OF FEBRUARY, 1914 AND 1915

	February, 1914 Quantity Long tons	February, 1914 Value	February, 1914 Av. price Per ton	February, 1915 Quantity Long tons	February, 1915 Value	February, 1915 Av. price Per ton
FERTILIZER SALTS:						
Kainite	72,008	$321,723	$ 4.47	1,852	$18,445	$ 9.95
Manure salts	12,451	124,422	9.90	900	14,748	16.39
Sulfate of potash	5,098	210,327	41.26	1,378	59,804	43.40
Chloride of potash	13,172	431,820	32.78	22,818	836,368	36.65
OTHER POTASH SALTS:	Pounds		Per lb.	Pounds		Per lb.
Carbonate of potash	1,674,685	49,110	$ 0.30	1,317,849	46,015	$ 0.30
Caustic potash	520,166	19,607	0.04	308,805	17,508	0.06
Nitrate of potash	22,699	928	0.04	.....	...	..
Cyanide of potash	5,641	890	0.16	266,654	39,327	0.15
Other potash salts	638,112	52,119	0.08	456,011	42,429	0.09

FERTILIZERS IMPORTED AND ENTERED FOR CONSUMPTION IN THE UNITED STATES, 1913–1914, IN LONG TONS

Fertilizer	1913 Quantity	1913 Value	1914 Quantity	1914 Value
Apatite	2,962	$22,471	20	$300
Bone dust or animal carbon, and bone ash, fit only for fertilizing purposes	35,012	851,136	36,000	892,529
Calcium cyanamid or lime nitrogen	26,729	1,410,248	21,793	1,119,785
Guano	16,674	518,429	25,335	761,562
Kainite	465,336	2,201,730	313,898	1,551,115
Manure salts, including double manure salts	223,687	2,245,509	168,969	1,846,475
Phosphates, crude	17,121	124,815	15,079	136,526
Slag, basic, ground or unground	13,186	130,455	9,199	105,272
All other substances used only for manure	154,729	3,314,460	171,603	3,507,875
TOTAL	955,436	10,819,253	761,896	9,921,439

MATERIALS ENTERING LARGELY INTO THE FERTILIZER INDUSTRY, FOR THE YEAR 1914, IN LONG TONS

	Quantity	Value
Imported[1]		
Fertilizers	761,896	$ 9,921,439
Potassium chloride	165,858	5,745,385
Potassium sulfate	35,914	1,557,224
Sodium nitrate	545,730	15,204,539
Domestic phosphate rock	2,734,043	9,608,041
TOTAL	.....	$42,036,628

[1] Bibliography of recent articles on the subject is also included.

There is also given in this report a long discussion of the progress of the searches made by the Geological Survey and the investigation by the Bureau of Soils looking for potash resources in this country; bibliography of recent articles on the subject is also included.

DEPARTMENT OF AGRICULTURE

Antagonism between Anions as Affecting Barley Yields on a Clay-Adobe Soil. CHARLES B. LIPMAN AND W. F. GERRICKE. "Journal of Agricultural Research," 4, 201–18. This is a report on tests of pot and field experiments as to the influence of sodium chloride, sulfate and carbonate, and calcium sulfate.

Methods Followed in the Commercial Canning of Foods. A. W. BITTING. Department Bulletin 196. Contribution from the Bureau of Chemistry. 79 pp. Paper, 10 cents. (This is a revision of Bureau of Chemistry Bulletin 151.) The discussion includes a description of modern factory equipment and methods of canning and does not deal with subjects of interest in connection with home canning of food.

The Production of Lumber in 1913. Department Bulletin 232. Contribution from the Forest Service, Office of Industrial Investigations. 32 pp. Paper, 5 cents.

Studies on Fruit Juices. H. C. GORE. Department Bulletin 241. Contribution from the Bureau of Chemistry. 19 pp. Paper, 5 cents. "This bulletin will be of interest only to those concerned with the commercial manufacture of fruit juices. The methods given call for cold storage, sterilization in carbon dioxide, and other processes not commonly available to the house-wife."

Native Pasture Grasses of the United States. DAVID GRIFFITHS, GEORGE L. BIDWELL AND CHARLES E. GOODRICH. Department Bulletin 201. Contribution from the Bureau of Plant Industry. 52 pp. Paper, 15 cents. This bulletin reports the results of investigations and of compilations, mainly of experiment station literature, relating to a large variety (more than 140 species) of native grasses. In almost every case, analyses are given of samples taken by the Department as well as summaries of analyses recorded in the literature.

The Alcohol Test in Relation to Milk. S. HENRY AYERS. Department Bulletin 202. Contribution from the Bureau of Animal Industry. 35 pp. Paper, 5 cents. The object of the work is stated as follows: "The principal object of this work was to determine the practical value of the alcohol test as a test for the quality of market milk. As incidental to our primary object, it was our purpose to determine some of the causes for the precipitation or coagulation of milk by alcohol."

The general effect of the test is indicated as follows: "The test is considered positive when a precipitate is formed, or in other terms, when a coagulum is produced. When a positive test is obtained with fresh milk from a single cow or small herd, it is generally believed that it indicates an abnormal milk, due to physiological or pathological conditions in the cow. A positive test with market milk is supposed to indicate that changes have been produced in the milk as a result of bacterial fermentations."

Composition of Corn (Maize) Meal Manufactured by Different Processes and the Influence of Composition on the Keeping Qualities. A. L. WINTON, W. C. BURNET AND J. H. BORNMANN. Department Bulletin 215. Contribution from the Bureau of Chemistry. 31 pp. Paper, 5 cents. "The main purpose of this paper is to show the general composition of American table meal milled by different processes, and especially the keeping qualities of the extreme types dried to different degrees and stored in different localities. Incidentally the composition of grits and the by-products are considered."

The most general conclusions that are drawn from a study of the products from 41 mills are given as follows: "A study of all the results leads to the conclusion that degerminated, bolted meal containing not over 14 per cent of moisture and 1 per cent of fat, as determined by the method of the Association of Official Chemists, properly stored, should keep for 6 months; with a moisture content of 15 per cent it should keep 3 months. Schindler's limit for moisture, namely $13^1/_2$ per cent, obtained by drying in an open dish, corresponds to about $14^1/_2$ per cent by the method of the Association of Official Agricultural Chemists.

"Whole-kernel meal, like cream, should be produced locally and consumed soon after grinding; properly dried, degerminated meal, like butter, keeps well during transportation and long storage."

The bulletin contains the results of a large number of analyses of the various products.

Drug Plants under Cultivation. W. W. STOCKBERGER. Farmers' Bulletin 663. Contribution from the Bureau of Plant Industry. 39 pp. Paper, 5 cents. This bulletin gives general cultural discussions and suggestions regarding harvesting, distillation, and marketing with a description of the more important drug plants; it is "suitable for general distribution."

Citrus Fertilization Experiments in Porto Rico. C. F. KINMAN. Bulletin 18. Porto Rico Agricultural Experiment Station. 33 pp. Paper, 10 cents. "To determine the comparative effects of the three fertilizer constituents—nitrogen, phosphoric acid, and potash—or to prove which is the limiting factor in fruit production on those soils, there was given to each of three plats an incomplete fertilizer, or a mixture containing but two of these elements. Each plat was given one of the three possible combinations. To compare the results from complete and incomplete mixtures and to determine the relative values of nitrate of soda, sulfate of ammonia, and dried blood, of muriate and sulfate of potash, a number of plats to be given a complete fertilizer were arranged. The tables give in detail the materials applied to the individual plats in each orchard."

PUBLIC HEALTH SERVICE

Public Health Administration in Toledo. CARROLL FOX. Public Health Reports, 30, 1873–1930. This report includes a discussion of a number of matters of chemical and municipal engineering interest. A description of the sewage disposals, water supply and garbage and rubbish handling systems of the city are given as well as a discussion of the general foot inspections and other testing and laboratory work done by the Board of Health of this city.

COMMERCE REPORTS—MAY 22 TO JUNE 30, 1915

A German patent has been granted to H. Stefferis for making a lubricant from **beet sugar molasses.** (P. 864.)

It is proposed to organize a nitrate holding company in Chile, with a capital of nearly $10,000,000, to regulate the price of

nitrate, and to increase the production and export. (P. 874.)

American interests are about to erect factories in China for the manufacture of **dried and desiccated eggs.** (P. 891.)

The Krupp works are making a burglar-proof safe, constructed of **steel** which required $1^1/_2$ hrs. with an oxyacetylene flame, to produce a hole 2 in. in diameter in a plate 1.5 in. thick.

A yellow **dye,** suitable for silks, is being made from the berries of the bush *Phamnus Tinctoria* which grows in Asia Minor. (P. 898.)

New by-product **coke ovens** have been erected in Monmouthshire, England. (P. 918.)

The Government **oil fields** of Chubut, Argentina, produced, in 1914, over 275,000,000 bbls. of oil, which is refined there. (P. 920.)

Importations of **potash salts** into the United States, from January 1 to April 30, 1915, show a marked decrease from the amount in the corresponding period of 1914. (P. 922.)

The world's **coffee** production in 1914 was 893,000 tons, a decrease of 92,000 tons from 1913. (P. 955.)

The Bureau of Standards is engaged in a study of the **spectroscopic analysis of steels,** which has shown the presence of Mo, Co, V, Ni, and Cr in regular irons and steels. (P. 967.)

The mineral products of Canada include **copper, gold, iron, lead, nickel, silver, asbestos, coal, gypsum, natural gas, petroleum, pyrites, salt, cement, clay, lime, and stone.** (Supplement 23*e*.)

The Philippine Bureau of Science has just completed a survey of the deposits of **iron ore** in Surigao Province, P. I. The deposit is a surface blanket of iron-bearing clay, resulting from the weathering of serpentine. (P. 979.)

A **vanilla-producing** plant (*Vanilla ovolis*) has been found in the Philippines. (P. 994.)

Activity is shown in the Philippine **sugar industry.** Hawaiian sugar cane has been introduced and found preferable to the local cane. (P. 995.)

The annual **gold** output of Nicaragua is about $2,500,000. The high-grade deposits have been exhausted, and the low-grade ores can be operated only on a large scale, preferably by cyaniding, of which considerable development is expected. (P. 1000.)

The water hyacinth removed from rivers in French Indo China to aid navigation, is now burned and the ashes used as a **fertilizer** for rice. (P. 1006.)

The **coal** output of Chile is increasing. (P. 1012.)

Efforts are being made to utilize the present surplus of bananas in Jamaica, by converting them into **banana flour,** which is used together with wheat flour. (P. 1019.)

A preliminary report of the Philippine Bureau of Science on the **gold** deposits near Iligan, Mindanao, states that the ore is a conglomerate and contains variable amounts of gold, up to $25 per ton. (P. 1034.)

An abstract is given of the methods of dyeing and bleaching **cocoanut fiber,** described in a paper by S. G. Bailey. (P. 1047.)

Tachienlu, China, is one of the world's principal musk markets, the **musk** being obtained from a gland of a male deer, of a species likley to become extinct. The musk is said to be radioactive. (P. 1053.)

Among the important products of Siam are **soya beans, kapok** (tree fiber), **stick lac, gum dammar** and **catechu.** (P. 1055.)

In an improved Philippine **copra** drier 850 cocoanuts can be dried in $3^1/_2$ hrs.

The **copra** industry of the Philippines is increasing, although the price is below normal. (P. 1082.)

A new **steel plant** has just been started at Newcastle, Australia, with a 350 ton blast furnace, three open hearth furnaces, a structural steel and rail mill, and sixty by-product coke ovens. Most of the expert steel workers were brought from the United States. (P. 1091.)

Efforts are being made to develop new markets for the following products from Chile: **sodium nitrate, copper, borax, sodium sulfate, tin, iodine, iron, and sulfur.** (P. 1098.)

A rubber **goods** factory is to be erected at Bandoeng, Java. (P. 1126.)

There is a marked decrease in **sugar beet** cultivations in all European countries except Italy and Russia, which show an increase. (P. 1145.)

The **coal** industry of Nottingham, England, is increasing, both domestic and steam coal being obtained. A large number of **by-product coke ovens** have been installed. (P. 1160–4.)

The **coal exports** of the United States, both anthracite and bituminous, fell off in the early part of the war, but are now above normal. (P. 1164.)

In a report by Thomas H. Norton on the **potash** situation, it is stated that owing to the greatly decreased imports into the United States, the price of potash salts has advanced from $38 to $160 or $175 per ton. Over 20,000 tons of potash salts purchased by American firms are still interned in German ports. Efforts to develop the American potash industry are promising. The American Trona Company, operating at Searles Lake, California, expects soon to market **potash, borax,** and **sodium chloride, sulfate,** and **carbonate.** Development in the Imperial Valley, California, awaits railroad facilities. A plant is being erected at Marysville, Utah to extract the potash from the **alunite** deposits. The utilization of **kelp** on the Pacific is progressing. One company has an output of one ton per day of nearly pure potassium chloride. Much of the kelp is being used wet as a fertilizer, and a large part is dried and pulverized, *e. g.*, for use in mixed fertilizers. The various processes of extracting the potash from kelp are briefly considered. (Pp. 1166–9.)

A new Brazilian **oil nut,** the product of *Ostesphorum platysperinum* (myristica platysperma) has been examined at the Kew Gardens, Liverpool, and found to contain 55.2 per cent of a white crystalline fat with a slight odor and the following constants: Melting point, 43° C.; solidifying point, 39° C.; saponification value, 240.2; iodine number, 6.3; refractometer reading at 40°, 36.9; free fatty acids (calculated as oleic), 5.3. It will probably prove suitable for alimentary purposes. (P. 1187.)

Shipments of **antimony ore** and **regulus** from Hankow, China, are increasing, the price being four times the normal. (P. 1188.)

A new **zinc factory** is to be erected in Japan, to use Siberian ores, formerly shipped to Germany and Belgium. (P. 1191.)

In an effort to promote the development of **platinum** refineries in Russia, the exportation of any large quantities of crude platinum was prohibited. No refineries were opened, however, and now efforts are being made to increase the export of platinum to the United States. (P. 1211.)

The manufacture of **cocoanut oil** in the Philippines is increasing, most of the output being sent to the United States. (P. 1227.)

Exports of **rubber** from the Malaysian States show an increase over last year. (P. 1239.)

The consumption of Chilean **nitrate** in the United States is increasing. (P. 1247.)

Owing to the scarcity of **coal** in Holland, the street lights are burning at only half strength. (P. 1254.)

Balata, from Guiana and Venezuela, a plant with a milky latex similar to **rubber,** is finding increasing use in the manufacture of belting. (P. 1283.)

In spite of the demand for Swedish **wood pulp,** the output is restricted by lack of fuel and shipping facilities. (P. 1292.)

The price of **tungsten** and **ferrotungsten** in England is still increasing. (P. 1297.)

The output of the Hanyang Iron Works, China, in 1914, was 135,000 tons of **pig iron** and 98,500 tons of **steel.** (P. 1324.)

The entire **coal** output of China in 1914 was 9,272,000 tons. (P. 1324.)

The Canadian Government proposes to open new timber lands in Ontario for the manufacture of **paper pulp**, under terms requiring the contractor to erect pulp and paper mills costing not less than $1,750,000. (P. 1338.)

Owing to a shortage of **gas coal**, the price of gas in Nottingham, England, has been advanced 12.5 per cent; and in other localities still more. (P. 1341.)

The price of **spelter** in Birmingham, England, has advanced from $105 to $525 per ton. (P. 1341.)

A new **tin** mining district has been opened on the east coast of Johore, Federated Malay States. (P. 1364.)

Considerable amounts of **manjack**, a bituminous substance used in the manufacture of insulating **varnishes**, protective **paint**, etc., are being shipped from Trinidad to the United States. (P. 1408.)

The use of **carbide slime** from acetylene generators, in the preparation of building mortar is suggested in Germany. (P. 1417.)

Efforts are being made to develop the **tanning industry** in the Philippines to utilize large amounts of hides now almost wasted. (P. 1432.)

A monograph (Special Agents' Series No. 99) upon the **"Cottonseed Industry in Foreign Lands,"** by Dr. Thomas H. Norton, discusses the foreign conditions and the field for American products. (P. 1442.)

Efforts are being made to develop the **paper** industry of India. In a report by the Indian Director General of Commercial Intelligence, the nature of the foreign competition, and the available resources of India are described. The raw materials emphasized are bamboo and savannah grass. (Pp. 1444–6.)

Imports of **potash salts** into the United States show still further decreases. (P. 1447.)

The total output of the German **amber** industry in 1914 amounted to $1,250,000. (P. 1447.)

The ash of seaweed collected in Manila Bay contains 5 per cent of **potash**. (P. 1457.)

Special supplements were published during the month as follows: In general they contain discussions of the manufacturing an trade conditions and in most cases import and export statistics.

Bulgaria—3*a*
France, Havre—5*c*
Marseille—5*d*
Greece, Athens—7*b*
Italy, Florence—8*a*
Netherlands, Amsterdam—9*a*
Norway, Bergen—10*a*
Spain, Madrid—15*b*
Turkey, Smyrna—18*b*
Abyssinia—79*b*
United Kingdom, Ireland—19*j*
Bradford—19*k*
Hull—19*l*
Costa Rica—24*a*
Dominican Republic, Puerto Plata—26*a*
Dutch West Indies—27*a*
Haiti—30*a*
Colombia—42*a*
China, Manchuria—52*b*
Shanghai—52*c*
Canton—52*d*
Japan, Jauvan (Formosa)—55*b*
Korea, Chosen—55*c*
British North Borneo—59*a*
British South Africa—66*b*

DEMANDS FOR AMERICAN PRODUCTS (PP.)

BRAZIL—1121
Dyestuffs
Drugs
Chemicals
Refrigeration supplies
Enameled ware
Hardware
Porcelain
Crockery
Cement (1380)

RUSSIA—1430
Borax
Yellow wax
White wax
Resin
Gum tragacanth
Dextrin
Nitric acid
Castor oil
Cottonseed oil
Cocoanut oil
Ammonia

CHINA—1179
Sheet glass

Holland—1254, Sweden—1258 France—1366, and Argentina—1381
Coal

STATISTICS OF EXPORTS TO THE UNITED STATES

NORWAY—Sup. 10*a*
Aluminum
Ferrochrome
Guano
Hides
Codliver oil
Paints

SPAIN—Sup. 15*b*
Ergotin
Licorice root
Castile soap
Fusel oil
Soap stock
Sulfur oils
Olive oil
Almond oil
Iron oil
Garnets
Sugar beet pulp
Glycerine
Peanuts
Saffron
Calcium tartrate
Beeswax

DOMINICAN REPUBLIC—Sup. 26*a*
Beeswax
Hides
Sugar
Cottonseed

DUTCH WEST INDIES—Sup. 27*a*
Aloes
Bones
Castor beans
Divi divi
Guano
Hides
Resin
Salt

HAITI—Sup. 30*a*
Fustic
Hides
Logwood
Wax
Shellac
Copra

SHANGHAI—Sup. 52*c*
Antimony
Beeswax
Chemicals
Earthenware
Gold
Grease
Hides
Pig iron
Vegetable oils
Paper
Tin
Zinc ore

HANKOW, CHINA—Sup. 52*c*
Albumen
Antimony
Gall nuts
Hides
Pig iron
Wood oil
Cottonseed oil
Sesame seed
Vegetable tallow

STATISTICS OF EXPORTS TO THE UNITED STATES

MEXICO—Sup. 32*a*
Bones
Glycerine
Hides
Ixtle fiber
Mercury
Guayule rubber
Beeswax
Chicle
Sarsaparilla
Vanilla
Calamine
Turpentine
Vegetable wax
Gold
Lead
Silver
Copper
Tin ore
Arsenious acid
Resin

PANAMA—Sup. 35*a*
Balata gum
Cocobolo
Hides
Ipecac
Rubber
Jagua (Ivory) nuts

BRAZIL—Sup. 40*a*
Brazil nuts
Carnauba wax
Gold
Hides
Manganese ore
Monazite
Rubber
Sugar
Precious stones

BRITISH GUIANA—Sup. 44*a*
Balata gum
Cocoanuts
Diamonds
Gold
Hides
Rum
Sugar

HONGKONG, CHINA—Sup. 52*a*
Aniseed
Aniseed oil
Camphor
Cassia
Cassia oil
Earthenware
Glassware
Paper
Peanuts
Peanut oil
Sugar
Tin

AUSTRALIA—Sup. 60*b*
Butter
Coal
Coke
Tin
Stearin
Eucalyptus oil
Copper
Glue stock
Hides
Nickel matte
Cocoanut oil

BRAZIL—994
Rubber

PHILIPPINES—1092
Hemp
Sugar
Vegetable oils
Copra

HAVRE, FRANCE—Sup. 5*c*
Aluminum
Animal charcoal
Antimony
Bronze
Brass
Casein
Copper
Drugs
Dyewood extracts
Glue
Glycerine
Hides
Indigo
Colza oil
Oleostearin
Flint pebbles
Prussiate of potash
Rubber
Tin
Porcelain
Vanilla
Kaolin
Linseed oil
Rapeseed oil
Paper
Tallow
Zinc oxide

CANADA—Sup. 23*e*
Coal
Coke
Drugs
Chemicals
Hides
Leather
Metals
Minerals
Paper

CUBA—Sup. 25*a*
Asphalt
Cocoanuts
Copper ore
Hides
Bones
Iron ore
Molasses
Sugar
Beeswax

ARGENTINE—1173
Bone meal
Bones
Casein
Fertilizer
Glue stock
Glycerin
Hides
Linseed
Neat's-foot oil
Quebracho extract
Stearin
Tallow
Copper

MARSEILLES, FRANCE—Sup. 5*d*
Ferro tungsten, etc.
Cochineal
Gall nuts
Gums
Bauxite
Glue stock
Sulfur oil
Crude olive oil
Vegetable tallow
Hides
Rubber
Nickel matte
Paper stock
Graphite
Tin
Aluminum
Tartaric acid
Glycerine
Prussiate of potash
Licorice
Vanilla
Glue
Coco butter
Copra oil
Peanut oil
Sesame oil
Ocher
Zinc oxide
Parchment paper
Castile soap
Wines
Emery

GREECE—Sup. 7*b*
Gum mastic
Marble
Chrome ore
Magnesite ore
Pumice
Hides
Wines, etc.
Amyl alcohol
Olive oil
Opium
Saffron

ITALY—Sup. 8*a*
Hemp
Porcelain
Marble
Terra cotta
Hides
Drugs and chemicals
Dyeing and tanning extracts
Glue stock
Artificial silk
Crude tartar
Beet pulp
Glycerine

BRADFORD, ENGLAND Sup. 19*k*
Emery
Formic acid
Antimony compounds
Dyes
Isinglass
Potassium carbonate
Grease and oils
Hides
Iron and steel
Paper stock
Artificial silk

TURKEY—Sup. 18*b*
Chrome ore
Emery
Gum mastic
Gum tragacanth
Licorice root
Olive oil
Sesame oil
Opium
Soap
Valonia
Galls

HULL, ENGLAND—Sup. 19*l*
Cement
Carbolic acid
Ammonium sulfate
Barium peroxide
Creosote
Creosote oil
Creosote, saponified
Cresol
Fish glue
Glycerine
Fertilizer
Glue stock
Oleine
Castor oil
Colza oil
Linseed oil
Rape oil
Rice oil
Soya bean oil
Sunflower oil
Washing blue
Oxide of iron
Ultramarine
Paper stock

COSTA RICA—Sup. 24*a*
Hides
Gold
Rubber
Silver
Sugar

COLUMBIA—Sup. 42*a*
Silver
Hides
Ivory nuts
Rubber
Cottonseed
Balsam copaiba
Balsam Tolu
Gold
Ipecac
Platinum
Mangrove extract

MANCHURIA—Sup. 52*b*
Soya bean oil
Hides
Talcum

CANTON, CHINA—Sup. 52*d*
Antimony
Aniseed oil
Hides
Cassia

KOREA, CHOSEN—Sup. 55*c*
Gold
Graphite

BRITISH NORTH BORNEO—Sup. 59*a*
Rubber
Cutch (mangrove extract)

BRITISH SOUTH AFRICA—Sup. 66*b*
Aloes
Argol
Buchu leaves
Hides
Chrome ore

TAIWAN, FORMOSA—Sup. 55*b*
Camphor

NETHERLANDS—Sup. 9*a*
Cinchona bark
Copal gum
Condensed milk
Drugs and chemicals
Earthenware
Hides
Kapok
Linoleum
Magnesite
Milk sugar
Milk powder
Oils
Paper
Quinine
Rags
Rubber
Straw pulp
Paraffin wax
Tin

IRELAND—Sup. 19*j*
Fusel oil
Paper stock
Whiskey

BOOK REVIEWS

Chemistry of Common Things. By BROWNLEE-FULLER-HANCOCK-WHITSIT. Teachers of Chemistry in New York High Schools. Allyn and Bacon, New York. 1914. 12mo., viii and 616 p. Price, $1.50.

This book is a decided departure from the traditional elementary text. Quoting from the preface: "As the title indicates, this book deals with the chemistry of every-day affairs. It is designed to meet the growing demand that high-school courses should prepare the pupil for citizenship. In other words, the book is planned for that large number of students who are limited to a single course in chemistry. The facts and principles of such a course should be of practical use throughout life."

"In an endeavor to meet the varying needs of such students, a wide range of topics has been treated. This will enable the teacher to select a course best suited to the requirements of his community. To this end, particular attention has been given to the chemistry needed for the first courses in industrial, technical, and agricultural schools, as well as in those teaching domestic science....."

The book is divided into two parts: Part I discusses the fundamental ideas and practical topics of universal interest under the following chapters: Chemical Action; Direct Combination; Acids, Bases, Salts; Weight Relations; Nomenclature and Valence; Writing of Chemical Equations; Solutions; Burning and Oxidation; Fuels, Fireplaces and Stoves; Gas and Gasoline Stoves; Oil and Gas Lights; Air and Ventilation; Chemical Purification; Water; Typical Properties of Metals; Carbon Compounds (Hydrocarbons, Substitution Products, and Alcohols); Carbon Compounds (Aldehydes, Acids, Esters, and Carbohydrates); Foods.

In Part II, "The authors have striven to group a large amount of interesting information around scientific principles and to make it both usable and scientifically accurate." The chapters are: The Cooking and the Adulteration of Foods; Bread Making; Milk; Cream, Ice Cream, Butter and Cheese; Cleaning and Laundering; Ink; Textile Materials; Dyes and Dyeing; Photography; Paints, Oils, and Pigments; Distillation of Petroleum, Wood, and Coal; Blast Lamps and Blowpipes; Gas Engines; Extraction of Metals; Electric Furnaces; Electrochemistry; Corrosion of Metals; Cleaning of Metals; Iron and Steel; Lime, Cement, and Building Materials; Brick and Pottery; Glass; Commercial Chemicals; Agriculture; Chemical Calculation.

Each chapter is taken up in a very systematic manner, each topic being assigned a number, making references very accessible. The illustrations are aptly chosen and the descriptions and explanations clearly stated. At the end of each chapter is a clear, brief summary of every topic treated, followed by a list of well selected questions bearing on the chapter. The many drawings and illustrations add greatly to the worth of the text.

The book contains quite a few scientific inaccuracies. "The change of one substance into another is called *chemical change*" (p. 1). From this definition the change of ice into water is chemical. "Boric acid and its salts are largely employed as food preservatives" (p. 19). Valence is spoken of (pp. 55 and 205) as the combining power of an atom instead of a property of an atom. Throughout the book the word nascent is used as it is on page 67: "Nascent oxygen is considered to be atomic oxygen (oxygen as it occurs at the instant it is liberated from a chemical compound)." The definition given for saturated solution (p. 87) is a better definition for supersaturation, but since supersaturation is not touched on in the chapter it will answer. The explosive range of acetylene in air is not 3–30 per cent as given on page 134, but 3–52 per cent, and under some conditions as high as 75 per cent (Butterfield). In the manufacture of Welsbach mantles the cotton threads are never impregnated before weaving (p. 136), but always after weaving the mantle. The pressure of Blau gas (p. 139) is 80 to 100 atmospheres, not 20.

The germicidal action of bleaching powder in water purification (p. 181) is credited to the nascent chlorine and not to the hypochlorite or hypochlorous acid; and on page 232, "The hypochlorous acid is itself an oxidizing agent and the chlorine liberates oxygen from the water in the fiber." Also on page 555, "The active agent of bleaching powder is believed to be nascent oxygen." $Cl_2 + H_2O \longrightarrow 2HCl + O$ (nascent oxygen). In the description of the manufacture of sugar (p. 236), "The purified syrup is then concentrated in vacuum pans, run out into tanks, and allowed to crystallize, forming the granulated sugar of commerce." In the manufacture of American Cheese (p. 298), "The process may be briefly outlined as follows: Sweet skimmed milk is heated to about 86° F. and the rennet added." Unskimmed is what is intended. In the Hall Process for Aluminum (p. 406), "An artificial mixture of fluorides, containing the fluorides of sodium, calcium and aluminum....., and the aluminum collects in the lower part of the box, from which it is drawn from time to time by removing a wooden plug from the taphole." The natural fluoride cryolite is used and since aluminum has a melting point of 657° C. a wooden plug would hardly be suitable. In the sentence, "Soda should never be allowed to come in contact with aluminum for it will turn it black" (p. 466), the last four words should be changed to "dissolves it." In the description of the blast furnace (a very clear description for an elementary text) the statement is made (p. 470) that "ferric oxide is reduced by the carbon;" this should read reduced by the carbon monoxide, etc. The topic Minor Sources of Nitrogen (p. 570) has the statement, "Leather and hair are subjected to the fumes of hydrofluoric acid in order to render available the nitrogen they contain."

The authors, who by the way are the authors of an admirable text on Elementary Chemistry used extensively in the high schools, fulfilling the requirements of the Board of Regents and the College Entrance Board, are undoubtedly sincere in their conviction that their most recent production is the kind of chemistry best suited to the majority of the students passing through their hands. The book is exceedingly practical, especially the first part, and many of the chapters are well selected to prepare the student for citizenship. It should have a tendency to stimulate the young mind to scientific study, especially chemistry, and if so then the systematic study of chemistry could, to added advantage, begin in the college, the engineering, or the technical schools. The authors deserve credit for being the pioneers in this field and the work will undoubtedly meet with favor.

ARTHUR C. NEISH

American Fertilizer Hand Book. Eighth Edition, 1915. 400 pages. Price, $1.00. Ware Bros. Company, Philadelphia.

This book follows the form of the previous editions and covers the standard reference statistics and directory features of the fertilizer and allied trades. An adequate idea of the scope of this work may be obtained from the following list of subjects treated: The National Fertilizer Association, Fertilizer Materials Statistics, American Potash, Agricultural Experiment Stations, State Fertilizer Officials, Conversion Tables, German and Other Sources of Potash Supply, Sulfate of Ammonia and Nitrate of Soda, Tankage and Blood, Sulfate of Ammonia Statistics, Middle West Soil Improvement Committee, Sulfuric Acid Industry, World Movement of Fertilizer Materials, Southern Soil Improvement Committee, Net Returns per Acre of Cultivated Lands of the United States, Use of Concrete in Fertilizer Plants, Dictionary of Fertilizer Materials, Five Years of Cyanamid in America, Fertilizer Tonnage, Reference Index, Reference Library, State Fertilizer Tonnage, Phosphate Rock Section, Cottonseed Section, Packers and Renderers Section.

M. C. WHITAKER

NEW PUBLICATIONS

By IRENE DEMATTY, Librarian, Mellon Institute of Industrial Research, Pittsburgh

Agricultural Chemistry: Chimie agricole. By E. CHANCRIN. 5th Ed. 16mo. 251 pp. Price, $2.00. Hachette et Cie, Paris.

Alternating Currents: A Treatise on the Theory of Alternating Currents. By ALEX. RUSSELL. New Ed. 8vo. Price, $3.75. G. P. Putnam's Sons, New York.

Analysis: Cours d'analyse mathematique. Vol. 3. By EDOUARD GOURSAT. 2nd Ed. 674 pp. Price, $5.00. Gauthier Villars, Paris.

Atoms: Principien der Atomdynamik. By J. STARK. 8vo. 280 pp. Price, $2.25. S. Hirzel, Leipzig.

Concrete: Reinforced Concrete Field Handbook. By JEROME COCHRAN. 12mo. 133 pp. Price, $1.00. Concrete-Cement Age Publishing Co., Detroit.

Concrete Stone Manufacture. By H. WHIPPLE. 8vo. Price, $1.00. Concrete-Cement Age Publishing Co., Detroit.

Copper: Kupfer. By WILHELM BORCHERS. 8vo. 450 pp. Price, $7.00. W. Knapp, Halle.

Dielectric Phenomena in High Voltage Engineering. By F. W. PEEK, JR. 8vo. 265 pp. Price, $3.00. McGraw-Hill Book Co., New York.

Diesel Engine: Ueber den Dieselmotor, seine Erprobung und seine Treibmittel. By MAX BARTH. 4th Ed. 8vo. 32 pp. Lipsius & Tischer, Kiel.

Dyestuffs: The Analysis of Dyestuffs and Their Identification in Dyed and Colored Materials, Lake-Pigments, Foodstuffs, Etc. By ARTHUR G. GREEN. 8vo. 154 pp. Price, $2.25. C. Griffin & Co., London.

Electrochemistry: Elektrochemie waesserige Loesungen. By FRITZ FOERSTER. 2nd Ed. 8vo. 804 pp. Price, $8.00. J. A. Barth, Leipzig.

Electrochemistry: Lehrbuch der Elektrochemie. By SVANTE ARRHENIUS. 8vo. 305 pp. Price, $2.00. J. A. Barth, Leipzig.

Engineering. By G. D. KNOX. 8vo. 288 pp. Price, $1.00. T. C. & E. C. Jack, Edinburgh.

Engineering Index Annual. 1914. 8vo. Price, $3.50. A. F. Bird, London.

Grinding Machinery. By J. J. GUEST. 8vo. 456 pp. Price, $3.75. E. Arnold, London.

Internal-Combustion Engine. By H. E. WIMPERIS. 2nd Ed. 8vo. 336 pp. Price, $1.50. Constable & Co., London.

Lifting Apparatus. Die Hebezeuge, Berechnung und Konstruktion der Elemente, Flaschenzuege, Winden und Krane. By HUGO BETHMANN. 3rd Ed. 8vo. 790 pp. Price, $5.50. Vieweg & Sohn, Braunschweig.

Lignite: Handbuch fuer den deutschen Braunkohlenbergbau. 2nd Ed. 8vo. 880 pp. Price, $11.00. W. Knapp, Halle.

Masonry as Applied to Civil Engineering. By F. N. TAYLOR. 8vo. 230 pp. Price, $2.50. D. Van Nostrand Co., New York.

Mechanical Engineers' Pocketbook of Tables, Formulae, Rules and Data. By D. KINNEAR CLARK. 12mo. 742 pp. Price, $1.25. C. Lockwood, London.

Micrometers, Slide Gauges and Calipers. By A. W. MARSHALL. 8vo. 78 pp. P. Marshall, London.

Milk: Analysis of Milk and Milk Products. By H. LEFFMANN. 4th Ed. 12mo. Price, $1.25. P. Blakiston's Son & Co., Philadelphia.

Petroleum Technologist's Pocketbook 1915. By SIR BOVERTON REDWOOD AND A. W. EASTLAKE. 16mo. Price, $2.25. C. Griffin & Co., London.

Platinum: Fusion du platine et dissociation. Prepared by HENRY LE CHATELIER. 8vo. 120 pp. Armand Colin, Paris.

Radioactivity: The Electrical Nature of Matter and Radioactivity. By H. C. JONES. 3rd Ed. 8vo. 212 pp. Price, $2.00. D. Van Nostrand Co., New York.

Railroad Field Manual for Civil Engineers. By W. G. RAYMOND. 8vo. Price, $3.00. Chapman & Hall, London.

Statics: A Treatise on Statics. Vol. 2. By G. MINCHIN. 5th Ed. 8vo. 369 pp. Price, $2.60. Oxford University Press, New York.

Steam Engine: A Manual of the High-Speed Steam Engine. By H. K. PRATT. 8vo. 270 pp. Price, $2.00. D. Van Nostrand Co., New York.

Steam Generators. Dampfkesselschaeden. By GEORG FRANTZ. 8vo. Price, $0.75. Gebrueder Boehn, Kattowitz.

Surface Tension and Surface Energy and Their Influence on Chemical Phenomena. By R. S. WILLOWS AND E. HATSCHEK. 8vo. 88 pp. Price, $0.75. Churchill, London.

Wastes: Utilisation des débris des animaux et déchets de la boucherie. By R. LEZÉ. 2nd Ed. 12mo. 297 pp. Charles Amat, Paris.

Welding: A Practical Manual of Autogenous Welding. (Oxy-Acetylene). By R. GRANJON AND P. ROSEMBERG. 3rd Ed. 8vo. 256 pp. Price, $1.50. C. Griffin & Co., London.

Welding: Oxy-Acetylene Welding and Cutting. 8vo. Price, $1.25. E. and F. N. Spon, London.

RECENT JOURNAL ARTICLES

Blast-Furnace Plant Auxiliaries and General Arrangement. By J. E. JOHNSON, JR. *Metallurgical and Chemical Engineering*, Vol. 13 (1915), No. 7, pp. 429–439.

Cast-Iron: Ueber den Einfluss des Phosphors auf die mechanischen Eigenschaften des grauen Gusseisens. By F. WUEST AND R. STOTZ. *Ferrum*, Vol. 12 (1915), No. 8, pp. 105–116.

Colloids: The Uses of Colloids in Plating Solutions. By E. S. THOMPSON. *The Brass World*, Vol. 11 (1915), No. 6, pp. 251–252.

Compressed-Air Meter. *Engineering and Mining Journal*, Vol. 99 (1915), No. 25, pp. 1077–1078.

Concrete: The Microscope in the Study and Investigation of Concrete. By N. C. JOHNSON. *Concrete*, Vol. 10 (1915), No. 6, pp. 288–296.

Copper: Absorption of Gases by Refined Copper. *Engineering and Mining Journal*, Vol. 100 (1915), No. 2, p. 52.

Copper: Classifying Commercial Copper. By L. ADDICKS. *The Steel and Metal Digest*, Vol. 5 (1915), No. 6, pp. 259–263.

Copper: Ueber die elektrolytische Kupferraffination. By FRANZ ALTNEDER. *Metall und Erz*, Vol. 12 (1915), No. 9, pp. 173–178.

Copper: Ueber eine handliche Methode zur Kupfersulfatbestimmung in Kupfervitriolen des Handels. By GEORG INCZE. *Zeitschrift fuer analytische Chemie*, Vol. 45 (1915), No, 5. pp. 252–255.

Formaldehyde: Ueber Formaldehydsalze. By H. FRANZEN AND L. HAUCK. *Journal fuer praktische Chemie*, Vol. 91, No. 7/8, pp. 261–284.

Furnace Curves. By R. J. WEITLANDER. *Metallurgical and Chemical Engineering*, Vol. 13 (1915), No. 7, pp. 425–428.

Furnace Practice in the Brass Foundry. By R. MICKS. *The Mechanical Engineer*, Vol. 35 (1915), No. 908, p. 486.

Ice-Making as a By-Product of Central Stations. By H. COCHRAN. *Journal of the American Society of Mechanical Engineers*, Vol. 37 (1915), No. 7, pp. 369–374.

Ions: The Relative Migration Velocities of the Ions in Complex Electrolytes. By A. MUTSCHELLER. *Metallurgical and Chemical Engineering*, Vol. 13 (1915), No. 7, pp. 439–442.

Iron-Ore: The Formation and Distribution of Bog Iron-Ore Deposits. By C. L. DAKE. *Bulletin of the American Institute of Mining Engineers* (1915), No. 103, pp. 1429–1436.

Kaolin: Ueber den Ersatz von englischen Kaolin durch einheimische Materialien. By REINHOLD RIEKE. *Sprechsaal*, Vol. 48 (1915), No. 22, pp. 191–193.

Metallurgical and Chemical Engineering in Great Britain. *Metallurgical and Chemical Engineering*, Vol. 13 (1915), No. 7, pp. 443–446.

Mineral Oils: Ueber Neurungen auf dem Gebiete der Mineraloelanalyse und Mineraloelindustrie im Jahre 1914. By LEOPOLD SINGER. *Chemische Revue ueber die Fett- und Harz-Industrie*, Vol. 22 (1915), No. 6, pp. 51–53.

Motors: Geschlossene Elektromotoren. By A. SEYFFERTH. *Zeitschrift des Vereins deutscher Ingenieure*, Vol. 59 (1915), No. 20, pp. 395–400.

Motors: Industrial Uses for Electric Motors. By T. R. HAY. *The Engineering Magazine*, Vol. 49 (1915), No. 4, pp. 498–516.

Ores: Cyanidation of Low-Grade Sulfide Ores in Colorado. By H. C. PARMELEE. *Metallurgical and Chemical Engineering*, Vol. 13 (1915), No. 7, pp. 421–425.

Papermaking: Some Uses of Electricity in Papermaking. By J. P. MALLETT. *Paper*, Vol. 16 (1915), No. 16, pp. 15–18.

Phenol: Bromine Method of Estimating Phenol. By W. VERSFELD. *The Analyst*, Vol. 40 (1915), No. 471, pp. 281–283.

Plating: The Successful Nickel Plating of Die Castings or Articles Made from Sheet Zinc. By C. H. PROCTOR. *The Metal Industry*, Vol. 13 (1915), No. 7, p. 274.

Rubber: What the Rubber Chemists are Doing. *The India Rubber World*, Vol. 52 (1915), No. 4, pp. 536–538.

Soya Bean Oil: Die Oxydation und Polymerisation des Sojabohnoels. By N. J. A. TAVERNE. *Zeitschrift fuer angewandte Chemie, Aufsatzteil*, Vol. 28 (1915), No. 42, pp. 249–251.

Steam: Ionizzazione spontanea del vapore acqueo dell'atmosfera e sua importanza nell'economia naturale. By G. ODDO. *Gazzetta Chimica Italiana*, Vol. 45 (1915), No. 5, pp. 395–412.

Steel: Comparison of Heat Treated Steels. By ROBERT R. ABBOTT. *Iron Trade Review*, Vol. 57 (1915), No. 1, pp. 22–23.

Steel: Surface Decarburization of Steel. By J. G. AYERS, JR. *Iron Trade Review*, Vol. 56 (1915), No. 25, pp. 1305–1306.

Sulfur: The Estimation of Sulfide and Sulfate Sulfur, and the Action of Solvents on Vulcanized Rubber. By H. P. STEVENS. *The Analyst*, Vol. 40 (1915), No. 471, pp. 275–281.

RECENT INVENTIONS

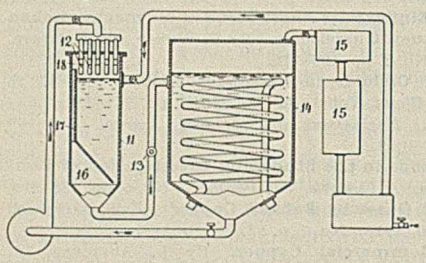
UNITED STATES PATENTS

By C. L. Parker

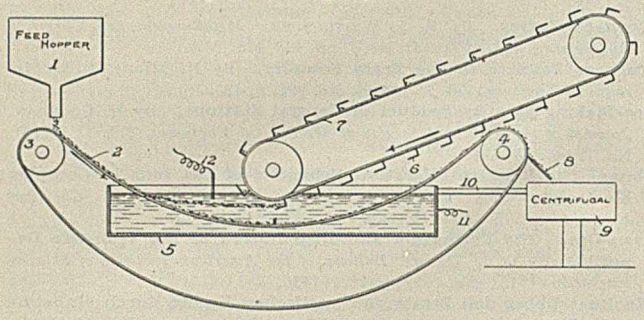
Solicitor of Chemical Patents, McGill Building, Washington, D. C.

Hardening Oils. K. Birkeland and O. Devik, Jan. 19, 1915. U. S. Pat. 1,125,259. Hydrogenation is effected by forming an unconfined jet of a mixture of oil and a catalyzer and causing the jet to pass first through an atmosphere of hydrogen and then onto a body of oil whereby hydrogen is carried down into the body of oil and is absorbed as it rises through the latter.

Fig. 1.

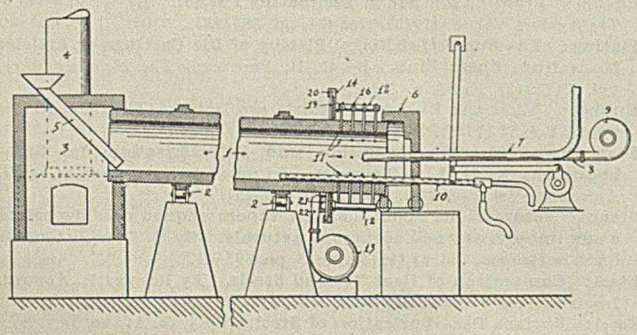


Treating Ores. J. W. Emerson, Feb. 2, 1915. U. S. Pat. 1,126,965. The blende is separated from concentrates containing it, by passing a shallow traveling layer of the concentrates into and through a bath which causes a preferential gas-evolving attack upon the blende to an extent only sufficient to lift the blende particles slightly above the surface of the layer and mechanically removing the thus lifted blende aggregates from the mass.

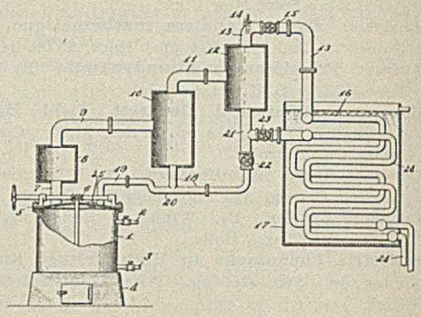


The bath may consist of a ten per cent aqueous solution of sulfuric acid, hydrochloric acid or nitric acid; or, it may consist of salt or sulfate of soda, in which case an electric current is passed through the liquid from suitable insoluble electrodes to cause an evolution of acid or chlorine which produces a preferential attack upon the blende particles, sufficient to cause their separation from the other particles of the concentrates.

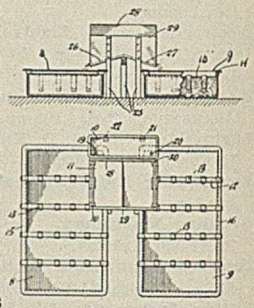
Recovery of Metallic Oxids from Flue-Dust. G. F. Downs, Feb. 2, 1915. U. S. Pat. 1,127,209. Flue-dust is passed in a continuous mass through a rotative cylindrical kiln or furnace slightly inclined from the horizontal and subjected to blasts of air through numerous tuyeres so regulated that the air is admitted underneath the flue-dust and not only violently agitates it, but creates sufficient heat through the combustion of the carbon contained in the flue dust with the oxygen contained in the air to sinter or nodulize the flue dust.



Improving Oils. A. McD. McAfee, Feb. 9, 1915. U. S. Pat. 1,127,465. This is a process of converting a portion of the high boiling petroleum oils into lower boiling oils by heating the higher boiling oils with aluminum chlorid and distilling off the lower boiling oils formed. The heated oil is cooled while a substantial amount of higher boiling oils remain therein and the aluminum chlorid is separated from the higher boiling oil.



Sodium-Carbonate Crystals. M. Spazier, Feb. 9, 1915. U. S. Pat. 1,127,691. The apparatus consists of two adjacent tanks 8 and 9, a third tank 10, adapted to discharge into either tank 8 or 9 and a drain receptacle 11, located above tanks 8 and 9.



In the use of this apparatus the crystals start their formation about the hangers 13 which are evenly distributed in the tanks 8 and 9 and at such a distance apart that they do not prevent the crystals falling to the bottom, when, in the process of crystallization, a sheet of crystals has formed. After crystals have formed in one tank the cross-bars 12 and hangers 13 are removed and any solution which is not crystallized is taken out of the tank and placed in tank 10. The crystals are then placed in the draining receptacle 11 and the excess or remaining solution is allowed to drain into tanks 8 and 9.

Recovery of Formic Esters Used as Solvents of Cellulose Compounds. J. Duclaux, Feb. 9, 1915. U. S. Pat. 1,127,871. The vapors of the solvent are absorbed in water containing an alkaline agent. A strong acid and a large excess of methyl or methyl alcohol is then added to the dilute solution and the resultant formic ester recovered by distillation.

Deposition of Iron. S. O. Cowper-Coles, Feb. 9, 1915. U. S. Pat. 1,127,966. Iron sponge is added to an electrolyte maintained in suspension and distribution by agitation whereby the acid which is formed is neutralized as rapidly as possible.

Fuse-Igniting Powder. S. Lilley, Sr., Feb. 9, 1915. U. S. Pat. 1,128,158. The powder is composed of chlorate of potash, sugar, sulfur, and cobalt.

Explosive. F. Sparre, Feb. 16, 1915. U. S. Pat. 1,128,380. The composition comprises an oxidizing agent and a polysulfide of an alkaline earth metal.

Gas. G. M. S. Tait, Feb. 16, 1915. U. S. Pat. 1,128,549. A fixed gas is produced from hydrocarbon oils without material deposition of carbon, tar or the like, by passing them through the pores of a heated porous non-metallic decomposing substance maintained at a temperature of between 1000° F. and 1600° F.

Hydrogen-Peroxid Solution. J. A. Trimble, Feb. 16, 1915. U. S. Pat. 1,128,637. This is a 3 per cent aqueous solution of hydrogen peroxid containing one part of cinchonidin to approximately 20,000 parts of hydrogen peroxid solution.

BRITISH PATENTS

By D. Geddes Anderson
Chemical Engineer and Patent Chemist, Glasgow, Scotland

The following abstracts are taken direct from the patent specifications as soon as these are published by the British Patent Office. The date given at the end of the abstract is date of acceptance.

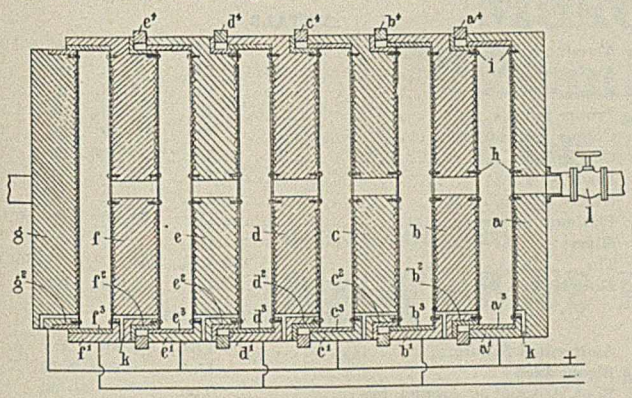
Treatment of Fabrics Used in Conjunction with India Rubber. W. E. Muntz. Feb. 25, 1913. Brit. Pat. 4910. Fabrics to be subsequently used in the manufacture of rubber goods are treated in an evacuated vessel, with a 3 per cent solution of barium hydroxide and then with a 3 per cent solution of ammonium carbonate. The insoluble barium carbonate precipitated in the fibers neutralizes the sulfuric and sulfurous acids formed after the vulcanization of the rubber.—April 1, 1915.

Dyeing or Softening Wood at High Temperatures. L. Petersen-Hviid, Dec. 23, 1913. Brit. Pat. 29,614. The wood, either in its natural condition or impregnated with liquids which will soften or color it, is heated in a closed vessel to a suitable temperature. When the temperature reaches about 135° C. a stream of gaseous ammonia under pressure is introduced. This treatment prevents the acids which are liberated from the wood at this temperature from injuring the wood fiber.—March 25, 1915.

Manufacture of Casein Binding Material. L. Petersen-Hviid, Jan. 14, 1914. Brit. Pat. 1016. Infusorial earth is added to the freshly precipitated curd. This addition gives a uniform drying and oxidation of the casein products and makes it very easily soluble in alkali.—April 14, 1915.

Improved Rubber Substance. P. Schidrowitz and H. A. Goldsbrough, Jan. 15, 1914. Brit. Pat. 1111. This relates to a process for obtaining a porous or spongy rubber substance direct from rubber latex. The latter is coagulated under conditions producing a spongy coagulum, and the pores so produced fixed by vulcanization. The coagulum is vulcanized in a wet state. One example quoted is: Equal quantities of latex, and a saturated solution of ammonium carbonate are heated on a water bath and 1 per cent of sulfur stirred in. Coagulation is induced by adding acetic acid and the mixture then vulcanized for one hour at 286° F.—April 15, 1915.

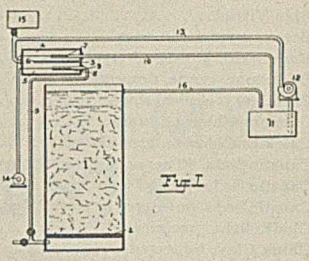
Utilization of Peat. M. A. Adam and Wetcarbonizing, Ltd., Feb. 14, 1914. Brit. Pat. 3888. Wet peat is subjected to heat treatment and dewatered to the condition of a solid or semi-solid mass. It is then subjected to an electric current under con-



ditions adapted to secure electrosmose, and to pressure in a space of gradually decreased volume. The drawing shows the new type of filter press, which has collapsible chambers and is provided with electrodes in each chamber to pass current through the cakes of peat when formed.—April 14, 1915.

Agglomerated Combustibles. L. Martel, March 26, 1914. Brit. Pat. 7664. This invention relates to the manufacture of agglomerated combustibles made with cool, ground pitch, and tar. The improvement consists of atomizing the tar by compressed air or steam before adding it to the coal and pitch. When the tar is added in this fashion less than 1 per cent is required.—March 25, 1915.

Extraction of Metal from Metal Bearing Material. W. H. James, April 21, 1914. Brit. Pat. 9846. A solution of a salt, such as sodium chloride, is electrolyzed in a separate electrolyzer. The respective electrolyzed solutions in the vicinities of the electrodes are withdrawn and the anode product is passed to a receptacle containing the metal-bearing material. The solution, after dissolving the base metal, is withdrawn from the material and is mixed with the solution from the cathode of the

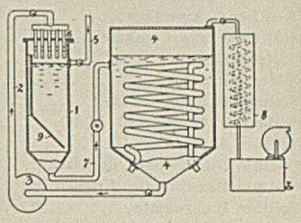


electrolyzer and the metal content is precipitated: 1 is a vat provided with filter flour 2; 3 is the electrolyzer with electrodes 7 and 8, which are surrounded by pipes 9 and 10 for withdrawing the solutions.—April 15, 1915.

Alloys of Iron and Steel. B. Talbot, April 29, 1914. Brit. Pat. 10,582 and 10,877. Copper, 0.3 per cent to 3 per cent, is added to soft steel or ingot iron. The metal is then rolled down to a suitable sized flat, cut up and piled. The piles are heated in a furnace to a welding temperature and are then cogged or hammered and rolled into sheets. The alloy is said to possess great powers of resisting corrosion.—April 15, 1915.

Composite Briquette Fuel. E. Eaton. May 8, 1914. Brit. Pat. 11,345. The material consists of: chalk 88 per cent, solidified tar 12 per cent. This mixture is ground, and during the grinding process is subjected to steam impregnated with petroleum oil vapor obtained by passing the steam through a closed tank containing oil.—March 25, 1915.

Refining and Distillation of Oils. K. Birkeland and O. Devik, May 14, 1914. Brit. Pat. 11,588. A mixture of oil and water vapor is produced by forming a jet of the oil and causing this jet to pass first through an atmosphere of water vapor and then into a body of oil. In this manner the water vapor forms an emulsion with the oil and the emulsion is passed into a low pressure receptacle where the vapor is allowed to escape and become condensed. An autoclave 1 is connected with a receptacle 4, which communicates



with a vacuum pump. Water vapor is led through 5 and oil through injectors 6. The emulsion is conveyed through 7 to the low pressure chamber 4.—April 8, 1915.

Cellulose Compounds. Courtaulds Ltd. W. H. Glover and L. P. Wilson, May 27, 1914. Brit. Pat. 13,055. Refers in particular to the manufacture of viscose. The oxidation of the alkali-cellulose is effected by blowing air through it, or by treating it with soluble peroxides, *e. g.*, 2 kilos of sodium peroxide are dissolved in 200 kilos of 17.5 per cent solution of caustic soda and 5 kilos wood pulp are immersed in the liquid at a temperature of 18° C. for about 4 hours. The product is then removed and pressed until it is about 15 kilos in weight, after which it is ground and at once converted into xanthate by the action of carbon bisulfide.—April 15, 1915.

Cleaning and Polishing Compound. C. E. Challis, June 23, 1914. Brit. Pat. 14,963. This consists of a mixture of kieselguhr, pumice, oxide of iron, rottenstone, emery, Neuberg chalk, oxalate of ammonia, and powdered soap. This mixture is made into a paste with oleic acid and a little Russian turpentine.—April 8, 1915.

MARKET REPORT—JULY, 1915

AVERAGE WHOLESALE PRICES IN THE NEW YORK MARKET FOR LARGE QUANTITIES OF STANDARD CHEMICALS

INORGANIC CHEMICALS

Acetate of Lime, gray	100 Lbs.	3.50	@	3.55
Alum, lump	100 Lbs.	3.25	@	3.50
Aluminum Sulfate, high-grade	100 Lbs.	1.25	@	1.50
Ammonium Carbonate, domestic	Lb.	9	@	9¼
Ammonium Chloride, gray	Lb.	6¾	@	7¼
Aqua Ammonium, 16°, drums	Lb.	2¼	@	2½
Arsenic, white	Lb.	4¼	@	—
Barium Chloride	Ton	100.00	@	110.00
Barium Nitrate	Lb.		15	
Barytes, prime white, foreign	Ton	20.00	@	25.00
Bleaching Powder, 35 per cent	100 Lbs.	1.62½	@	1.75
Blue Vitriol	Lb.	7¼	@	7¾
Borax, crystals, in bags	Lb.	5½	@	6
Boric Acid, powdered crystals	Lb.	9¼	@	9½
Brimstone, crude, domestic	Long Ton	22.00	@	22.50
Bromine, technical, bulk	Lb.	85	@	87
Calcium Chloride, lump	Ton	—	@	11.78
Calcium Chloride, granulated	Ton	—	@	14.78
Caustic Soda, 60 per cent domestic, in drums,	100 Lbs.		3.00	
Caustic Soda, 70 @ 76 per cent	100 Lbs.	2.87½	(basis)	
Caustic Soda, powdered or granulated, 76%	100 Lbs.	3.75	@	—
Chalk, light precipitated	Lb.	4½	@	5
China Clay, imported	Ton	30.00	@	35.00
Feldspar	Ton	8.00	@	12.00
Fuller's Earth, foreign, powdered	100 Lbs.	80	@	85
Glauber's Salt, in bbls	100 Lbs.	80	@	
Green Vitriol, bulk	100 Lbs.	90	@	1.00
Hydrochloric Acid, commercial, 18°	100 Lbs.	1.50	@	1.75
Hydrochloric Acid, C. P., conc., 22°	100 Lbs.	2.00	@	2.25
Iodine, resublimed	Lb.	3.75	@	3.80
Lead Acetate, white crystals	Lb.	11⅝	@	12⅛
Lead Nitrate	Lb.	11	@	11½
Litharge, American	Lb.	7	@	8
Lithium Carbonate	Lb.	1.00	@	1.10
Magnesium Carbonate	Lb.	5½	@	6
Magnesite, "Calcined"	Ton	25.00	@	30.00
Nitric Acid, 68 per cent, sp. gr. 1.42	Lb.	5⅞	@	6¼
Nitric Acid, fuming	Lb.	7⅞	@	8¼
Phosphoric Acid, sp. gr. 1.750	Lb.	28	@	31
Phosphorus	Lb.	35	@	90
Plaster of Paris	Bbl.	1.50	@	1.70
Potassium Bichromate, casks	Lb.	21	@	21½
Potassium Bromide	Lb.	1.10	@	1.11
Potassium Carbonate, calcined, 80 @ 85%	Lb.	20	@	21
Potassium Chlorate, crystals, spot	Lb.	42	@	
Potassium Cyanide, bulk, 98–99 per cent	Lb.	25	@	29
Potassium Hydroxide	Lb.	40	@	42
Potassium Iodide, bulk	Lb.	3.15	@	3.20
Potassium Nitrate, crude	Lb.	17¼	@	—
Potassium Permanganate, bulk	Lb.	95	@	1.00
Quicksilver, flask, 75 lbs.		95.00	@	100.00
Red Lead, American	Lb.	7¾	@	—
Salt Cake, glass makers'	100 Lbs.		55	
Saltpeter, crude	100 Lbs.	—	@	—
Silver Nitrate	Oz.	30½	@	32½
Soapstone in bags, Na_2O	Ton	10.00	@	12.00
Soda Ash, 48 per cent. Na_2O	100 Lbs.	67½	@	72½
Sodium Acetate	Lb.	5¾	@	6½
Sodium Bicarbonate, domestic	100 Lbs.	1.25	@	1.50
Sodium Bicarbonate, English	Lb.	3½	@	3¾
Sodium Bichromate	Lb.	10½	@	11½
Sodium Carbonate, dry	100 Lbs.	1.10	@	—
Sodium Chlorate	Lb.	17½	@	18
Sodium Hydroxide, 60 per cent	100 Lbs.		2.25	
Sodium Hyposulfite	100 Lbs.	1.80	@	2.00
Sodium Nitrate, 95 per cent, spot	100 Lbs.	—	@	—
Sodium Silicate, liquid	100 Lbs.	85	@	1.20
Sodium Sulfide, 30%, crystals, in bbls	Lb.	1¾	@	2¼
Sodium Sulfite, crystals	Lb.	2⅝	@	3¼
Strontium Nitrate	Lb.	17½	@	18
Sulfur, flowers, sublimed	100 Lbs.	2.20	@	2.60
Sulfur, roll	100 Lbs.	1.85	@	2.15
Sulfuric Acid, chamber, 60°	100 Lbs.		85	
Sulfuric Acid, conc., sp. gr. 1.842	100 Lbs.	1.25	@	2.00
Sulfuric Acid, oleum (fuming)	100 Lbs.	1.50	@	2.00
Talc, American	Ton	9.00	@	13.00
Terra Alba, American, No. 1	100 Lbs.	75	@	80
Tin Bichloride, 50°	Lb.	14¼	@	15
Tin Oxide	Lb.	44	@	45
White Lead, American, dry	Lb.	6¾	@	—
Zinc Carbonate	Lb.	10	@	12
Zinc Chloride, granulated	Lb	12½	@	14½
Zinc Oxide, American process	Lb.	16	@	18
Zinc Sulfate	100 Lbs.	6½	@	—

ORGANIC CHEMICALS

Acetanilid, C. P., in bbls	Lb.	65	@	70
Acetic Acid, 28 per cent, in bbls	100 Lbs.	2.50	@	2.65
Acetic Acid, glacial, 99½%, in carboys	Lb.	10½	@	11
Acetone, drums	Lb.		28	
Alcohol, denatured, 180 proof	Gal.	38	@	39
Alcohol, grain, 188 proof	Gal.	2.64	@	2.66
Alcohol, wood, 95 per cent, refined	Gal.	45	@	47
Amyl Acetate	Gal.	2.60	@	2.75
Aniline Oil	Lb.	1.23	@	1.30
Benzoic Acid, ex-toluol	Lb.	3.00	@	—
Benzol, 90 per cent spot	Gal.	90	@	1.00
Camphor, refined in bulk, bbls	Lb.	43	@	45
Carbolic Acid, U. S. P., crystals, drums	Lb.	1.50	@	—
Carbon Bisulfide	Lb.	7½	@	8
Carbon Tetrachloride, drums, 100 gals	Lb.	16	@	17
Chloroform	Lb.	30	@	35
Citric Acid, domestic, crystals	Lb.	75	@	80
Cresol, U. S. P.	Gal.	1.40	@	1.50
Dextrine, corn (carloads, bags)	100 Lbs.	3.10	@	3.20
Dextrine, imported potato	Lb.	—	@	—
Ether, U. S. P., 1900	Lb.	15	@	20
Formaldehyde, 40 per cent	Lb.	9	@	10
Glycerine, dynamite, drums included	Lb.	21½	@	22
Oxalic Acid, in casks	Lb.	34½	@	35½
Pyrogallic Acid, resublimed bulk	Lb.	1.35	@	1.55
Salicylic Acid	Lb.	2	@	2½
Starch, cassava	Lb.	3¼	@	4
Starch, corn (carloads, bags)	100 Lbs.		2.35	
Starch, potato	Lb.	5¼	@	—
Starch, rice	Lb.	7	@	8
Starch, sago	Lb.	3⅜	@	3⅞
Starch, wheat	Lb.	7	@	7½
Tannic Acid, commercial	Lb.	65	@	66
Tartaric Acid, crystals	Lb.	50	@	—

OILS, WAXES, ETC.

Beeswax, pure, white	Lb.	42	@	45
Black Mineral Oil, 29 gravity	Gal.	12½	@	13
Castor Oil, No. 3	Lb.	9¾	@	10¼
Ceresin, yellow	Lb.	10	@	25
Corn Oil	100 Lbs.	5.86	@	—
Cottonseed Oil, crude, f. o. b. mill	Gal.	38	@	—
Cottonseed Oil, p. s. y	Lb.	6	@	6⅛
Creosote, beechwood	Lb.	90	@	95
Cylinder Oil, light, filtered	Gal.	20	@	25
Fusel Oil, crude	Lb.	2.40	@	2.50
Japan Wax	Lb.	13	@	—
Lard Oil, prime winter	Gal.	88	@	90
Linseed Oil, raw	Gal.	53	@	54
Menhaden Oil, crude	Gal.	37	@	38
Naphtha, 68 @ 72°	Gal.	—	@	12
Neat's-foot Oil, 20°	Gal.	93	@	94
Paraffine, crude, 120 & 122 m. p.	Lb.	2½	@	3
Paraffine Oil, high viscosity	Gal.	22	@	23
Rosin, "F" Grade, 280 lbs.	Bbl.		3.80	
Rosin Oil, first run	Gal.	—	@	25
Shellac, T. N.	Lb.	13¾	@	14¼
Spermaceti, cake	Lb.		25	
Sperm Oil, bleached winter, 38°	Gal.	70	@	—
Spindle Oil, No. 200	Gal.	17	@	18
Stearic Acid, double-pressed	Lb.	12	@	12½
Tallow, acidless	Gal.	62	@	63
Tar Oil, distilled	Gal.	30	@	31
Turpentine, spirits of	Gal.	42	@	43

METALS

Aluminum, No. 1, ingots	Lb.	31	@	33
Antimony, Hallets'	Lb.		—	
Bismuth, New York	Lb.	2.75	@	—
Bronze powder	Lb.	65	@	4.00
Copper, electrolytic	Lb.	19	@	19¼
Copper, lake	Lb.	19½	@	19¾
Lead, N. Y.	100 Lbs.		5.55	
Nickel	Lb.	42	@	45
Platinum, refined	Oz.	45.00	@	50.00
Silver	Oz.		47⅜	
Tin	100 Lbs.	36.37½	@	36.50
Zinc, N. Y.	Lb.	20	@	20¼

FERTILIZER MATERIALS

Ammonium Sulfate	100 Lbs.	3.46	@	3.50
Blood, dried	Unit		2.70	
Bone, 4½ and 50, ground, raw	Ton		30.00	
Calcium Cyanamid	Unit of Ammonia		2.30	
Calcium Nitrate, Norwegian	100 Lbs.		—	
Castor Meal	Unit		—	
Fish Scrap, domestic, dried, f. o. b. works	Unit	2.52½	&	10
Kainit, minimum 12.4 per cent K_2O, bulk	Ton		35.00	
Phosphate, acid, 16 per cent, bulk	Ton	8.00	@	9.00
Phosphate rock; f. o. b. mine:				
Florida land pebble, 68 per cent	Ton		2.25	
Tennessee, 70–80 per cent	Ton	5.00	@	5.50
Potassium "muriate," basis 80 per cent	Ton	230.00	@	250.00
Pyrites, furnace size, imported	Unit		14	
Tankage, high-grade	Unit	2.65	&	10

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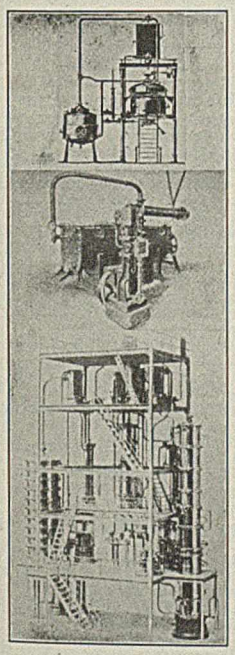
PROSPERITY



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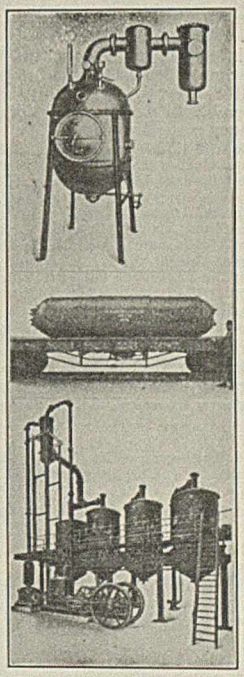

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Knight, Maurice A., Akron, Ohio.
U. S. Stoneware Co., The, Akron, O.

Acid Plants (Sulphuric, Nitric and Picric)
Moore & Sons Corp., Samuel L., Elizabeth, N. J.

Acid Proof Brick
German-American Stoneware Works, N. Y. C.
Knight, M. A., Akron (East Side), Ohio.
Thermal Syndicate, Ltd., New York City.
U. S. Stoneware Co., The, Akron, O.

Agitators, or Mixers
Dorr Cyanide Machinery Co., Denver, Col., and N. Y. City.
General Filtration Co., Inc., Rochester, N. Y.
Werner & Pfleiderer Co., Saginaw, Mich.

Air Compressors
Abbé Engineering Co., N. Y. City.
Crowell Engineering Co., Brooklyn, N. Y.
Hubbard's Sons, Norman, Brooklyn, N. Y.

Ammonia
Unger, John S., Chicago, Ill.

Analysis—Gas Apparatus
Bausch & Lomb Optical Co., Rochester, N. Y.
Braun Corporation, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Eimer & Amend, New York City.
Heil Chem. Co., Henry, St. Louis, Mo.
Lenz & Naumann, Inc., N. Y. C.
Sarco Engineering Co., New York City.
Scientific Materials Co., Pittsburg, Pa.

Analytical Apparatus
Bausch & Lomb Optical Co., Rochester, N. Y.
Braun Corporation, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Buffalo Dental Mfg. Co., Buffalo, N. Y.
Eimer & Amend, New York City.
Heil Chem. Co., Henry, St. Louis, Mo.
Leitz, Ernst, New York City
Lenz & Naumann, Inc., N. Y. C.
Sargent & Co., E. H., Chicago, Ill.
Scientific Materials Co., Pittsburg, Pa.
Thomas Co., Arthur H., Philadelphia, Pa.

Analytical Laboratories
Columbus Laboratories, Chicago, Ill.
Dearborn Chemical Co., Chicago, Ill.
Sadtler & Son, Samuel P., Philadelphia.

Asphalt Flow Plates
Howard & Morse, N. Y. C.

Atomizing Liquids Apparatus
(See Spray Nozzles.)

Bakelite
General Bakelite Co., New York City.

Balances and Weights
Bausch & Lomb Optical Co., Rochester, N. Y.
Braun Corporation, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Calif.
Eimer & Amend, New York City.
Heil Chem. Co., Henry, St. Louis, Mo.
Lenz & Naumann, Inc., N. Y. C.
Sargent & Co., E. H., Chicago, Ill.
Scientific Materials Co., Pittsburg, Pa.
Thomas Co., Arthur H., Philadelphia, Pa.

Bismuth
United States Metals Refining Co., N. Y. C.

Boilers
Sowers Mfg. Co., Buffalo, N. Y.

Boiler Water Treatment
Dearborn Chemical Co., Chicago, Ill.
Merck & Co., N. Y. C.

Blowers
Abbé Engineering Co., N. Y. C.
Crowell Mfg. Co., Brooklyn, N. Y.

Bolting Cloth
Abbé Engineering Co., N. Y. C.

Bone Black
Booth Apparatus Co., Syracuse, N. Y.

Books
Chemical Publishing Co., The, Easton, Pa.
Van Nostrand Co., D., N. Y. C.

Briquette Molds
Howard & Morse, N. Y. C.

Brimstone, Crude
Union Sulphur Co., New York City.

Burners—Bunsen
Tirrill Gas Machine Lighting Co., N. Y. C.

Burners—Gas and Oil
Bausch & Lomb Optical Co., Rochester, N. Y.
Braun Corporation, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Buffalo Dental Mfg. Co., Buffalo, N. Y.
Eimer & Amend, New York City.
Heil Chem. Co., Henry, St. Louis, Mo.
Lenz & Naumann, Inc., N. Y. C.
Sargent, E. H. & Co., Chicago, Ill.
Scientific Materials Co., Pittsburg, Pa.

Burners—Heating & Laboratory
Tirrill Gas Machine Lighting Co., N. Y. C.

Burners—Sulphur (Rotary)
Glen Falls Machine Works, Glen Falls, N. Y.

Calorimeters—Fuel and Gas
Bausch & Lomb Optical Co., Rochester, N. Y.
Braun Corporation, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Eimer & Amend, New York City.
Emerson Apparatus Co., Boston, Mass.
Heil Chem. Co., Henry, St. Louis, Mo.
Lenz & Naumann, Inc., N. Y. C.
Sarco Engineering Co., New York City.
Sargent, E. H. & Co., Chicago, Ill.
Scientific Materials Co., Pittsburg, Pa.
Thomas Co., Arthur H., Philadelphia, Pa.

Capsules
Norton Co., Worcester, Mass.
Thermal Syndicate, Ltd., New York City.

Carboy Stoppers
Knight, Maurice A., Akron, Ohio.

Castings (Acid and Heat Resisting)
Bethlehem Foundry & Machine Co., South Bethlehem, Pa.
Buffalo Fdy. & Mch. Co., Buffalo, N. Y.
Duriron Castings Co., N. Y. C.
Jacoby, Henry E., N. Y. C.
Moore & Sons Corp., Samuel L., Elizabeth, N. J.

Castings (Chemical)
Bethlehem Fdy. & Mach. Co., So. Bethlehem, Pa.
Buffalo Fdy. & Mch Co., Buffalo, N. Y.
Duriron Castings Co., N. Y. C.
Jacoby, Henry E., N. Y. C.
Werner & Pfleiderer Co., Saginaw, Mich.

Caustic Pots
Buffalo Fdy. & Mch. Co., Buffalo, N. Y.
Moore & Sons Corp., Samuel L., Elizabeth, N. J.

Caustic Soda
General Chem. Co., N. Y. C.
Hooker-Electrochemical Co., N. Y. C.

Cement Filler
Toch Brothers, N. Y. C.

Centrifugal—Separators
(See Separators—Centrifugal.)

Centrifugals
Braun Corporation, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Cal.
DeLaval Separator Co., N. Y. C.
International Instrument Co., Cambridge, Mass.
Schaum & Uhlinger, Inc., Philadelphia.

Charcoal
Booth Apparatus Co., Syracuse, N. Y.

Chemical Castings
Buffalo Fdy. & Mch. Co., Buffalo, N. Y.
Duriron Castings Co., New York City.
Werner & Pfleiderer Co., Saginaw, Mich.

Chemical Glassware
Caloris Co., Millville, N. J.
Carbondale Instrument Co., Carbondale, Pa.
Cooper Hewitt Electric Co., Hoboken, N. J.
Corning Glass Works, Corning, N. Y.
Macbeth-Evans Glass Co., Pittsburgh, Pa.

Chemicals
Badische Company, New York City.
Baker & Adamson Chemical Co., Easton, Pa.
Baker Chemical Co., J. T., Phillipsburg, N. J.
Bausch & Lomb Optical Co., Rochester, N. Y.
Braun Corporation, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Dearborn Chemical Co., Chicago, Ill.
Eimer & Amend, New York City
General Chemical Co., New York City.
Hoffman & Kropff Chem. Co., Brooklyn, N. Y.
Lenz & Naumann, Inc., N. Y. C.
Mallinckrodt Chem Co., St. Louis, Mo.
Merck & Co., New York City.
National Aniline & Chemical Co., N. Y. C.
Pfizer & Co., Charles, New York City.
Powers-Weightman-Rosengarten Co., Phila., Pa.
Sargent & Co., E. H., Chicago, Ill.
Scientific Materials Co., Pittsburg, Pa.
Squibb & Sons, E. R., N. Y. C.
Thomas Co., Arthur H., Philadelphia.

Chemical Plants (Complete Installation)
Lummus, Walter E., Boston, Mass.

Chemical Plants (Erected and Supervised)
M. McNamara, Everett, Mass.

Chemical Reagents
Baker & Adamson Chem. Co., Easton, Pa.
Baker Chem. Co., J. T., Phillipsburg, N. J.
Hoffman & Kropff Chem. Co., Brooklyn, N. Y.
Mallinckrodt Chem. Co., St. Louis, Mo.
Merck & Co., N. Y. C.

Chloride of Lime
Hooker-Electrochemical Co., N. Y. C.

Chlorine—Liquid
Badische Company, New York City.
Electro Bleaching Gas Co., N. Y. C.

Classifiers
Dorr Cyanide Mach. Co., Denver, Col., & N. Y. C.

Classifiers or Washers
Dorr Cyanide Mach. Co., Denver, Col., & N. Y. C.

Coal Tar Products
National Aniline & Chemical Co., N. Y. C.

Cocks—Plug (Acid Proof)
Duriron Castings Co., N. Y. C.

Colorimeters
Bausch & Lomb Optical Co., Rochester, N. Y.
Braun Corporation, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Eimer & Amend, N. Y. C.
Heil Chem. Co., Henry, St. Louis, Mo.
Lenz & Naumann, Inc., N. Y. C.
Sargent & Co., E. H., Chicago, Ill.
Scientific Materials Co., Pittsburg, Pa.
Thomas Co., Arthur H., Philadelphia, Pa.

Colors—Aniline and Alizarine
Farbwerke-Hoechst Co., N. Y. C.
National Aniline and Chemical Co., N. Y. C.

Combustion Tubes and Boats
Norton Co., Worcester, Mass.
Thermal Syndicate, Ltd., New York City.

Condensers (Barometric and Surface)
Buffalo Fdy. & Mch. Co., Buffalo, N. Y.
Jacoby, Henry E., N. Y. C.
Lummus, Walter E., Boston, Mass.

Consulting Chemists and Chemical Engineers
Abbott, W. G., Jr., Washington, D. C.
Foster, A. B., Washington, D. C.
Joseph, Irwin S., Rahway, N. J.
Little, Arthur D., Inc., Boston, Mass.
Munn, W. Faitoute, East Orange, N. J.
Ricketts, Dr. Pierre de P., N. Y. C.
Sadtler & Sons, Samuel P., Philadelphia.
Snelling, Walter O., Pittsburgh, Pa.
Stevens, Geo. H., Newark, N. J.
Unger, John S., Chicago, Ill.

Corn Oil (Extracted)
Woolner & Co., Peoria, Ill.

Crucibles
American Platinum Works, Newark, N. J. (Platinum).
Baker & Co., Inc., Newark, N. J. (Platinum)
Bausch & Lomb Optical Co., Rochester, N. Y.
Bishop & Co., J., Malvern, Pa. (Platinum).
Buffalo Dental Mfg. Co., Buffalo, N. Y. (Alundum).
Dixon Crucible Co., Joseph, Jersey City, N. J. (Graphite.)
Duriron Castings Co., N. Y. C. (Acid Proof).
Norton Co., Worcester, Mass. (Alundum).
Thermal Syndicate, Ltd., New York City (Vitreosil).

Crushers and Grinders (Industrial and Laboratory)
Abbé Engineering Co., New York City.
Bausch & Lomb Optical Co., Rochester, N. Y.
Braun Corporation, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco., Calif.
Eimer & Amend, New York City.
Raymond Impact Pulv. Co., Chicago, Ill.
Sargent & Co., E. H., Chicago, Ill.
Sturtevant Mill Company, Boston, Mass.
Williams Patent Crusher & Pulverizer Co., Chicago, Ill.

Cupels
Hoskins Mfg. Co., Detroit, Michigan.
Norton Company, Worcester, Mass.

Cylinders (Oxygen and Hydrogen)
International Instrument Co., N. Y. City.

Diaphragms
General Filtration Co., Inc., Rochester, N. Y.

Diffusion Apparatus
General Filtration Co., Inc., Rochester, N. Y.
Lummus, Walter E., Boston, Mass.

Dissolving Tanks—Automatic
Lummus, Walter E., Boston, Mass.
Werner & Pfleiderer Co., Saginaw, Mich.

Distilling Machinery and Apparatus
Badger & Sons Co., E. B., Boston, Mass.
Bausch & Lomb Optical Co., Rochester, N. Y.
Booth Apparatus Co., Syracuse, N. Y.
Braun Corporation, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Devine Company, J. P., Buffalo, N. Y.
Eimer & Amend, New York City.
Electric Heating Appliance Co., N. Y. C.
Elyria Enameled Products Co., Elyria, O., and N. Y. C.
German-American Stoneware Works, N. Y. C.
Heil Chem. Co., Henry, St. Louis, Mo.
Hoffman-Ahlers Co., Cincinnati, O., & N. Y. C.
Lenz & Naumann, Inc., N. Y. C.
Lummus, Walter E., Boston, Mass.
Sanborn Evaporator Co., N. Y. C.
Sargent & Co., E. H., Chicago, Ill.
Scientific Materials Co., Pittsburgh, Pa.
Stokes Machine Wks., F. J., Philadelphia.
Swenson Evaporator Co., N. Y. C.
Thomas Co., Arthur H., Philadelphia, Pa.
Unger, John S., Chicago, Ill.
Werner & Pfleiderer Co., Saginaw, Mich.
Zaremba Company, Buffalo, N. Y.

Dryers—Vacuum
Bethlehem Foundry & Machine Co., South Bethlehem, Pa.
Buffalo Fdy. & Mch. Co., Buffalo, N. Y.
Devine & Company, J. P., Buffalo, N. Y.
Jacoby, Henry E., New York City.
Stokes Machine Co., F. J., Philadelphia, Pa.
Werner & Pfleiderer Co., Saginaw, Mich.

Drying Apparatus and Machinery
Bethlehem Foundry & Machine Co., South Bethlehem, Pa.
Buffalo Fdy. & Mch. Co., Buffalo, N. Y.
Hoffman-Ahlers Co., Cincinnati, O. & N. Y. C.
Jacoby, Henry E., New York City.
Werner & Pfleiderer Co, Saginaw, Mich.

Ductility Machines
Howard & Morse, N. Y. C.

FOOD AND MILK CHEMIST, age 27, degree of pharmaceutical chemist from eastern college, desires position in industrial, bacteriological or public health laboratory. Experience of three years in analysis and bacteriology of food products. Willing to go anywhere in the United States. References can be furnished. Address "M. Sherwood Field, 62 Florida St., Ashmont, Massachusetts." 971-8-15

CHEMIST, university graduate, 30, experienced in physical and chemical testing or engineering materials, successful solution of practical problems, desires to make a change, where there is a future offered for ability. Good executive. Address "M. H. M.," care This Journal, Easton, Pa. 972-8-15

CHEMIST, B.Chem., Cornell University, 1913, age 24, possessing executive and initiative ability, would like to obtain position in chemical manufacturing concern. Organic and bacteriological chemistry or analytical work preferred. Best of references. Address "G. L. E.," care This Journal, Easton, Pa. 973-8-15

INDUSTRIAL CHEMIST AND CHEMICAL ENGINEER. Broad training. Wide experience. Latter includes plant design, construction, operation, costs, furnaces, electrothermics, heavy chemicals. Have handled men to advantage. Can supervise production or investigation. Vigorous and resourceful. Excellent record. Address "J. L. K. S." care This Journal, Easton, Pa. 974-8-15

CHEMIST, B.S., desires position with chances for advancement. Age 27, single. Excellent training in chemistry and chemical engineering. Broad experience in general analytical work. Have had charge of laboratory. Would be pleased upon request to furnish full information as to training and experience with references and photograph. Address "P. L. G.," care This Journal, Easton, Pa. 975-8-15

CHEMICAL ENGINEER (Columbia, 1915) wants to get into industrial field involving large raw product operations (e. g., sugar) and offering a good future. Would consider West Indian or Central American location. Address "R. G. P.," care This Journal, Easton, Pa. 976-8-15

YOUNG CHEMIST, 28, Hollander by birth, graduate of German university, with practice in big German dye-stuff factory, thorough analyst and scientific research chemist, seeks position. Would also consider position as professor's assistant. Address "P. G. W." care This Journal, Easton, Pa. 977-8-15

CHEMIST, ENGINEER, highly experienced in plant control by laboratory, research work and general plant superintendence, efficiency of plant department, desires change. Experienced in process development; hence desires new or growing company. Address "J. F.," care This Journal, Easton, Pa. 979-8-15

GRADUATE CHEMIST, age 29, desires position with manufacturing concern. Has had a thorough training and five years of analytical and research experience. Moderate salary where there is a good chance for advancement. Best of references furnished on request. Address "C. H. C.," care This Journal, Easton, Pa. 980-8-15

CHEMIST: Technical graduate. Have had charge of a textile laboratory for two years. Extensive experience in bleaching and dyeing. Within the last few months have assisted in perfecting a method of bleaching and purifying cotton for nitrating purposes. Have had practical experience in managing bleachery. Excellent references. Address "H. S.," care This Journal, Easton, Pa. 981-8-15

CHEMIST wishes position; any locality. Ten years' experience chiefly in manufacturing; eight years in last position. Prefers place as assistant to superintendent or as foreman, or manufacturing and research or analytical work combined. Experienced in supervising manufacturing processes in small plants. Has a university education, is conversans with six foreign languages and is a good typist. Address "C. B. A.," care This Journal, Easton, Pa. 982-8-15

CHEMIST, graduated from German university with practical experience in the manufacture of paints, varnish, organic acids, soap, casein, commercial bacteria cultures, etc., well versed in business matters, desires connection with manufacturing business. Investment. Age 37. References exchanged. Address "M. O. R.," care This Journal, Easton, Pa. 983-8-15

CHEMICAL ENGINEER, at present employed, having four years' practical factory experience, desires to improve position. Experienced in the manufacture of glycerine and the design of apparatus therefor; in the manufacture of toilet preparations and household specialties; in the use of perfumes for soaps, etc.; also in the manufacture of incandescent electric lamps. Now in charge of factory making hand soap, toilet and household specialties. Can take entire charge of factory, and get results. Address "L. R. N.," care This Journal, Easton, Pa. 984-10-15

CHEMIST, graduate, wishes to make a change. Eighteen years' experience in large iron and steel plants, making all grades of iron and steel; nine years as chief chemist. Any position where such experience would be of value. Address "K. R.," care This Journal, Easton, Pa. 985-8-15

FOOD CHEMIST, eight years' experience in food and drug analysis and control, at present state chemist with one of the State Food and Drug Commissions, desires a position in the commercial field. Address "S. C.," care This Journal, Easton, Pa. 986-8-15

CHEMIST-INSPECTOR desires new connection. Training and experience in FUELS such as to meet requirements of coal corporation or large user. Experienced in the sampling of cargo or large shipments of fuels, metals and ores; water softening; inspection and analysis of oils and metals. At present chemist-in-charge. Age 28. Address "Chemist-Inspector," care This Journal, Easton, Pa. 987-8-15

CHEMIST, Ph.D., with German and American training and factory, laboratory and teaching experience, well versed in organic chemistry, foods, pharmaceuticals, oils, fats, resins, colors, paints, varnishes, polishes, for a number of years in charge of a large concern manufacturing nitro-cellulose preparations, lacquers and solvents, wants position for full or part of time, preferably in or near New York. Address "Industrious," care This Journal, Easton, Pa. 988-8-15

TEACHER, graduate of leading university with seven years' experience in practical chemical work and ten years' experience in teaching industrial and organic chemistry, wishes position as teacher. Excellent references. Address "Ability," care This Journal, Easton, Pa. 989-8-15

SANITARY CHEMIST AND BACTERIOLOGIST with extended experience in water purification and sewage treatment wishes to secure position along these lines. Three years' experience in water and five years' in sewage work. B.S. degree. Age 28; married. Address "W. & S.," care This Journal, Easton, Pa. 990-8-15

COAL TAR FIRMS
STEEL FIRMS
EXPLOSIVE FIRMS

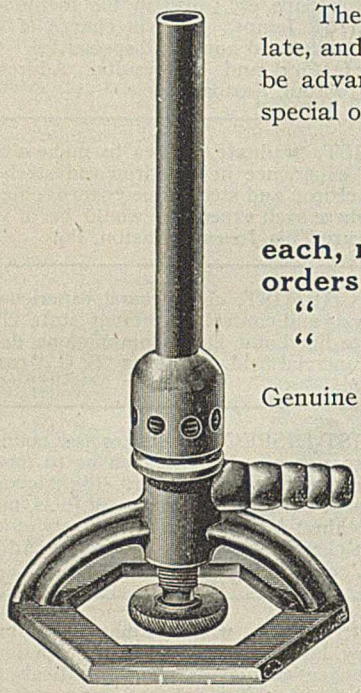
CHEMICAL ENGINEER desires to communicate with above or others interested in coal tar or its products. Capable of designing, constructing and operating plants for the distillation of coal tar and the manufacture of its by-products. Acquainted with the market of ALL the products. Address "X," care This Journal, Easton, Pa. 991-8-15

ANNOUNCEMENT

Concerning

The Genuine Tirrill Bunsen Burner for Coal, Gasoline, or Natural Gas

As special distributors of this widely known burner, which is recognized as the most efficient and economical moderate priced burner on the market, we are pleased to ***announce a special price offer for deliveries before September 1st, 1915.***



The market price of brass has risen considerably of late, and as further sharp advances are anticipated, it will be advantageous for purchasers to take advantage of this special offer before the prices are necessarily advanced.

PRICE LIST

Genuine Tirrill Bunsen Burner,

each, net, $ .80	per dozen, net,	$9.60
orders of 3 dozen or over,	" " "	8.25
" " 6 " " " "	" "	7.75
" "12 " " " "	" "	7.25

Genuine Tirrill Burners will operate just as efficiently with either coal gas, gasoline gas, or natural gas. They are made of solid, heavy brass, mounted on a hexagonal compo base, and are provided with separate air and gas adjustments, allowing for the convenient and quick adjustment of the flame to any length desired. They do not clog, sing or strike back, and allow of perfect combustion, thereby reducing to a minimum the gas consumption.

Genuine Tirrill Burners are used almost exclusively in the Chemical Laboratories of a great many large Institutions, such as Columbia University, Kentucky State University, University of Toronto, Pennsylvania State College, etc., etc.

No burner is a Genuine Tirrill unless the name is stamped thereon and unless manufactured by the Tirrill Gas Machine Lighting Company

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