bling the gas through the absorbent solutions in this manner a more rapid and complete absorption of gases is obtained, and this is superior to absorptions by contact and shaking, one passage of the gases being sufficient for complete absorption.

A rapid analysis for gases for gas engine control can thus be made in twelve to fifteen minutes, including analysis for carbon dioxide, oxygen, carbon monoxide, hydrogen and methane, and ethylene.

The idea of bubbling the gas through the solutions has been suggested by many, and has been applied, but not in so convenient a manner.

WESTINGHOUSE MACHINE CO.,
EAST PITTSBURG, PA.

REVIEW.

SOME PRESENT PROBLEMS IN INDUSTRIAL CHEMISTRY.[1]

BY EDWARD HART.
Received December 29, 1904.

IT has often seemed to me that we spend too much time in telling about what we have done and what we expect to do. Progress consists, after all, in doing things and not in talking about doing them. It is, therefore, somewhat out of harmony with my own wishes to appear here to-day in a general discussion of the problems of industrial chemistry. Those of us who are engaged in industrial work must often choose between glittering generalities and silence. The conditions are happily expressed in a reply received from a well-known technical chemist in answer to my request that he write a paper for this meeting. "It is not necessary for me to say" he replied "that my relations to most manufacturers are of a confidential nature, and so I cannot divulge the information imparted to me. I regret that we are so hidebound here for there is much that would be of general interest. I am ashamed to say, however, that there are many manufacturers who distrust the consulting chemist who talks or writes much."

To the manufacturing chemist sulphur is of prime importance. Heretofore we have, on the Atlantic seaboard, depended largely upon Sicilian sulphur and upon pyrite, only a part of which was of domestic production.

To these sources have been added in recent years the gases obtained in the roasting of zinc blende from which sulphuric acid is now made in quantity. Quite recently it is announced that suc-

[1] Read at the Philadelphia meeting of the American Chemical Society.

cess has been attained in roasting pyrrhotite, of which vast deposits exist, among other places, in southwest Virginia. Most of the sulphur imported has been used in the manufacture of paper. The western deposits of sulphur have not been extensively drawn upon, owing largely to their distance from consuming centers. The Louisiana deposits have attracted much attention, however, and it is gratifying to learn that the courage and perseverance shown by Mr. Herman Frasch have at last met their reward. He informed me last September in New York that he was then taking out 16,000 tons of sulphur per month. He has taken out as much as 23,000 tons from one well. The existence of 40,000,000 tons has been proved. The holes are drilled to a depth of 800 feet and a 13-inch casing driven in. Inside this a 10-inch, then a 3-inch, and finally a 1-inch pipe are inserted. Between the 3- and 10- and the 10- and 13-inch pipes superheated water is forced into the well by its own expansive force. The sulphur melts and rises to 400 feet in the 3-inch pipe, from which it is raised to the surface by compressed air through the 1-inch pipe. The molten sulphur is run upon the ground in ponds made of rough boards 72 feet square and 14 feet high. The sulphur costs $2.90 f.o.b., per ton.

In the *Engineering and Mining Journal* of October 27th, I read as follows: "In brimstone the absorbing topic is the rapid development of the domestic industry. It is learned that large paper mills have contracted for Louisiana sulphur and the outlook for more business in this direction is promising. The paper mills are the largest consumers of Sicilian sulphur and should the syndicate lose these orders it can be said importation will eventually cease. While considering the expansion of the American sulphur mining industry it is of interest to quote the opinion of Emil Fog & Sons, of Messina, on the position of the industry in Sicily. In their circular of October 1st the Messrs. Fog state that they have warned the Anglo-Sicilian Sulphur Co. of the danger of serious competition with the Louisiana mines, only to be treated with scorn. Now the Sicilian market is startled by the news that a steamer with 3,000 tons of American brimstone has actually been shipped from New Orleans to Marseilles and that other shipments are to be made to Antwerp and Hamburg. The Chambers of Commerce of Girgenti and Caltanisetti are agitating for government intervention and at last the Anglo-Sicilian Co. has been aroused. Local newspapers propose to raise a fund of £2,000 by subscription as a premium to the inventor of new methods for the employment of brimstone. Curiously, nobody thinks of the only remedy, namely, a radical reduction in prices."

In the same journal for November 3rd occurs the following: "The Louisiana mines will ship this week from New Orleans the largest single cargo of sulphur—7,500 tons—ever consigned to New York. These mines are shipping about 800 tons daily and one day recently reported 860 tons."

It is evident that we have at one stride ceased to be dependent upon others for our sulphur supplies, indeed that we have become, commercially speaking, the only source of supply. Further than this, if the estimate of the cost of production above given is found to be borne out by further experience the owners of these mines will be in a position to drive both pyrite and pyrrhotite from the market. May the golden shower of sulphur thus rained upon the owners of the mines and upon the nation be wisely administered so that it may be a blessing to both!

In the nine months ending September, 1904, 107,343 tons of brimstone were imported for consumption, or at the rate of 143,124 tons annually. At $22 per ton this means an addition of $3,148,728 annually to our national wealth.

During the nine months ending September, 1904, we imported 32,934 tons bleaching-powder, 220,368 tons sodium nitrate, 126,392 tons common salt, 41,092 tons potassium chloride, 7,511 tons soda ash, 1,920 tons sal soda, 923 tons caustic soda, 5,071 tons saltpeter, and 42 tons potassium chlorate. These figures I have arranged in a column in the accompanying table setting over against each the imports for the corresponding periods in 1902 and 1903. I have added to the above items a number of others to be taken up in detail later on. These figures are from "Advance Sheets from Monthly Summary of Commerce and Finance," issued by the United States Department of Commerce and Labor for September, 1904.

	1902.	1903.	1904.
Bleaching-powder	43,677	40,994	32,934
Potassium chlorate	463	154	42
Sodium nitrate	147,980	208,740	220,368
Sodium chloride	148,094	123,941	126,392
Potassium nitrate	4,620	5,742	5,071
Potassium chloride	25,559	50,269	41,092
Soda ash	10,082	8,637	7,511
Sal soda	1,514	1,341	1,920
Caustic soda	1,273	1,072	923
India rubber, gutta percha, and gutta-julatonga	20,266	26,209	28,223
Argols or wine lees	11,412	9,978	8,349
Coal-tar colors and dyes, value in dollars	3,718,782	3,848,289	3,879,197
Glycerin	10,382	14,248	11,289
Logwood	44,422	31,195	27,458
Logwood extracts	1,278	1,293	1,140
Gums	28,262	31,620	27,513
Indigo	1,439	1,972	2,066
Pottery (dollars)	7,134,311	8,372,911	8,626,064
Glass (dollars)	4,518,603	5,147,260	4,450,195
Leather (dollars)	3,632,253	3,920,285	3,787,788
Plumbago	13,738	13,242	9,791

These figures, while by no means exhaustive, give a fair idea of the progress of our chemical industries. It is evident that we are rapidly increasing our domestic production of salt, bleaching-powder, potassium chlorate, soda ash and caustic soda and will soon be able to cover our own needs. In the nitrates no progress has been made and the same thing is shown in potash salts. In these two articles we can expect no improvement unless native sources of supply can be found. Such a source of supply for nitrate has been found in Death Valley, Cal., where, according to Bailey of the State Geological Survey, 22,000,000 tons have been located. I paid a visit to these deposits in the winter of 1901-2. At that time a considerable party was at work locating the deposits for the American Nitrate Co., of San Francisco. To a tenderfoot the prospect of obtaining nitrate from these deposits seemed rather remote. They were 80 miles from a railroad, in a barren desert with very little water and no fuel, with a very high summer temperature and at a great distance from consuming centers. To this the reply may be made that the same thing is true of the borax deposits of Southern California. The conditions are, however, not quite parallel. Borax sells at present for about 7½ cents per pound and carries a duty of 5 cts., while nitrate sells for less than 2½ cts., and is on the free list.

Another possible source of nitrate is to be found in the method which has been under experiment by the Atmospheric Products Co., of New York. According to the best information obtainable the cost of this product is still too high. It is to be hoped that some such process may ultimately prove successful. This is one of the present problems worthy of thought and experiment.

If our own nitrates could be made at home, we should add $11,000,000 to our national income.

Another problem is the finding of a source of potash to equal or excel the Stassfurt potash. It is true that certain companies in the United States have acquired interests in these deposits, which places them upon a better footing than formerly but it is very desirable that an independent source of supply should be found. Such a source of supply we have in the feldspar rocks which have a wide distribution. It does not seem hopeless to look to these as a source of potash. We often forget that with the extension of industrial chemistry new uses are being found for substances heretofore valueless such as aluminum and silicon. May it not be possible some day to extract the potash from such rock and to utilize the silicon and aluminum as well?

If we can now roast pyrrhotite, make sulphuric acid from the sulphur, extract the copper and sell the residue to the blast-furnace, the hope that we may some day make our potash at home is not necessarily an iridescent vision.

One of the most pressing problems is a substitute for India rubber. While new sources of supply have been found and the old ones more carefully exploited, the use of rubber has increased more rapidly than the supply. With the advent of horseless vehicles this problem has become a really serious one, since the present great cost of the tire bids fair to seriously impede the growth of this industry. It has been found by experiment that the inflated tire for medium weight vehicles gives by far the best results in speed and power consumption. Let us hope that some future Acheson may do for the rubber industry what he has done for abrasives. In coal-tar colors and dyes the exhibit is not cheerful reading. Considerable progress, however, has been made during the two years just passed in various directions.

I do not at all despair of seeing the growth of an industry exceeding the German. Our imports of these articles do not, as it is, cut a very large figure in dollars, the total value for nine months being a little under four millions.

It is a matter of common knowledge that a large part of the glycerol thrown away in soap lyes ten years ago is now being recovered. Our home production must have increased enormously. Nevertheless, the figures given show that the importations are slowly increasing.

The decreased use of logwood is no doubt due to the increasing use of coal-tar dyes, especially the sulphur blacks, which have been found to be very satisfactory. Notwithstanding the growth of our own pottery trade the imports show a steady increase.

In glass the imports about hold their own. If methods now on trial for the manufacture of window glass prove successful, our export trade will no doubt increase; indeed our export trade in window glass though small even now shows a steady increase. In 1902 it amounted to $30,954, in 1903 to $43,320, and in 1904 to $56,710. In leather our imports remain practically stationary: $8,279,061 in 1902, $8,793,930 in 1903, and $7,968,723 in 1904. Our exports of unmanufactured leather for the same periods were $16,723,847, $17,673,082 and $18,916,558, and of manufactured leather $5,869,441, $6,685,288, and $6,688,792. In leather, then we are maintaining and increasing the lead we have held. If we remember that our own markets absorb constantly increasing quantities, the extent of our gain becomes evident.

Our production of plumbago, mostly artificial, seems still to be insufficient to meet our needs but the imports seem to be on the decrease. Probably this decrease will continue as the artificial product improves and the prejudice against it disappears.

Let us turn now for a moment to the products of the metallurgist: The imports of iron and steel excluding ore were for the three periods, $27,838,237, $34,652,234, and $16,591,000 while the exports were $73,352,000, $72,714,360, and $92,565,937. In 1903 we mined 32,471,550 tons of iron ore, produced a little over 18,000,000 tons pig iron and 4,500,000 tons of steel.

In this branch of industrial chemistry we are now acknowledged leaders. The recent discovery of Mr. James Gayley bids fair to still further increase this lead. Mr. Gayley finds that simply drying the blast causes a vast improvement in the operation of the furnace—a much greater improvement than could have been expected. Should the most moderate expectations be realized and a saving of 50 cents per ton of pig be realized, the total saving will amount to $9,000,000 annually. Let us cherish such men. The man who can add such a sum to our income is not born every day.

Of copper we imported $8,205,737, $12,677,907, and $13,744,979, and exported $36,566,174, $29,906,841 and $53,485,906. This gain in output has been accompanied by considerable improvements in methods and diminished cost of product.

Of lead we imported $3,400,120, $2,867,637 and $2,132,485 and exported $590,311, $354,709 and $443,615. Here there is evidently room for improvement. The figures showing production tell a different story. In 1894 we turned out 159,331 short tons and in 1903, 280,000 short tons. The increase in production from 1902-1903, however, was not large, only 10,000 tons.

In zinc we imported $66,012, $46,680 and $37,088 and exported $363,150, $187,208 and $666,912. Our production was in 1901 140,822 short tons and in 1903 159,219 short tons. We produced 46,500 tons zinc oxide in 1901 and 62,962 tons in 1903.

The production of aluminum has increased from 7,150,000 pounds in 1901 to 7,500,000 pounds in 1903.

According to "The Mining Industry for 1903" we are now producing about three-eighths of the pig iron, three-sevenths of the steel, one-fourth of the lead, one-fourth of the zinc, one-fifth of the gold and one-third of the silver of the whole world. Do not these figures show that we have nothing to be ashamed of, rather we have cause for gratification at the present position occupied by those industries whose foundation stone is chemistry. The progress made cannot, however, be shown in figures—it is much greater than figures will show—there has been an enormous improvement in the quality of our products. This is shown in metals, in leather, in drugs, for which we have a deservedly high reputation, and in nearly all of our heavy chemicals. The pure chemicals in common use when I began this manufacture in 1880 could not to-day be sold. Indeed, many commercial chemicals can now be used by the analytical chemist without further purification. This improvement in quality has been accompanied by a decrease in cost of production. To-day most pure chemicals used by the analyst sell for less than a third of their cost in 1880.

Those of us who remember the manufacturing chemistry of twenty-five years ago, while conscious that there is still much to do, cannot help feeling very proud of what has been accomplished. What of the future? To rest is to rust, and of that we are in little danger. Never in my recollection was the time so full of promise.

First, we are learning rapidly the need of coöperation. The manufacturer has need of the chemist, the engineer, the commercial man. Unless all concerned coöperate most cordially, success cannot be attained. Until the moneyed man learns patience and the chemist who dreams dreams and sees unsubstantial visions learns to touch the earth more frequently, this coöperation will not have been secured.

May we not hope and believe that many of us will live to see established in full operation here the greatest chemical industry the world has ever known? We have the natural resources, the market, the inventive genius, the commercial ability. To-day our great schools are turning out good chemists and we are rapidly learning to use them all to the best advantage. It would be foolish to ignore the great lead the old world, and especially Germany, has obtained in so many factory products, but this need not palsy our efforts. It is possible to regain what has been lost. It is impossible to believe that a free people, such as we, need fear any other in the industrial struggle. We have much to learn, but past experience shows that we can and will learn. Here are some more things to strive for:

1. It is desirable to find some cheaper way to burn cement. This, with steel, seems destined to be the great building material of the future and has already become of much commercial importance. Dr. J. W. Richards finds that nine-tenths of the heat used in the present method of burning is lost.

2. Better methods must be found for treating zinc ores. The metallurgy of zinc still belongs to the dark ages.

3. We must raise more of our sugar at home. We are enormous consumers and small producers of this important heat-producing food.

4. We must induce our farmers to fertilize their lands more heavily, so that we may at least restore to the land what is taken away.

5. We must make our own glass and our own pottery. We have already done much in this direction. Not the least important step forward is the formation of the American Ceramic Society. Much of our cheap ware is made at home, but the more expensive is mostly imported.

6. A beginning has already been made in what may be called organic industrial chemistry, but most remains to be done. It is humiliating to see to what an extent we are dependent upon the Germans and Swiss for such articles.

Several years ago I undertook to enter this field myself with two of my students who had just graduated. We found that there was a duty of 20 per cent. upon picric acid, and concluded this would be a good material with which to begin. We spent many weary days working up a process fit for manufacturing, but finally found it and began to put our product on the market. We had marketed perhaps a ton of the material in small lots when some one in New York discovered that picric acid was not a dye but an acid imported for manufacturing purposes and therefore not dutiable, and to our astonishment and dismay succeeded in convincing our learned Treasury officials that such was the case. This, with a disastrous fire which came shortly after, convinced us that we were not yet ready to do up the Germans.

7. In Clarke's tables giving the average composition of the earth's crust, so far as known to us, the rare element titanium—as we used to consider it—figures as ninth in importance, making up as TiO_2 0.6 per cent.; strange as it may seem there is more titanium than phosphorus in the earth's crust. Of the ten elements there given, titanium alone has so far found little industrial use. A beginning has, however, been made by Peter Spence & Co., of Manchester, who had a most interesting exhibit at St. Louis.

It was not my purpose to attempt anything like an enumeration of all the industrial problems confronting the chemist. What has been said will be sufficient to convince those who are hunting trouble that much remains to be done.

NOTES.

Some Observations on the Use of Alkaline Waters for Laundry Purposes.—The attention of the writer has been called recently to a somewhat interesting condition which develops when strongly alkaline artesian waters are used for laundry purposes in steam laundries. The starched portion of a garment, when placed upon the steam rollers to be ironed, develops a deep yellow color. Fehling's solution gave a test for glucose, and iodine revealed the presence of dextrin. A probable explanation of this phenomenon then would be that the starch is converted into dextrin by the heat of the steam rollers; this in turn is converted into glucose, and the glucose reacts with the alkali present in the water, forming some alkali compound which has the deep yellow color. No complaint has come from the domestic laundries; probably because an ordinary flat-iron is not heated to a sufficiently high temperature to cause the reaction.

A partial analysis of the water was made with the following result: