the excess titrated with equivalent alkali. The alkali reading is then looked up on the ordinate of the chart prepared for the feed of the particular moisture content found, and the crude protein reading made on the abscissa.

The charts are presented for the purpose of lightening the labors of other chemists doing similar work, and to suggest this simple method for calculating results, as an entire set of charts can be prepared in a very short time.

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GAS-WASHING APPARATUS WITH ENCLOSED FILTER[1]

By E. R. Weaver and J. D. Edwards

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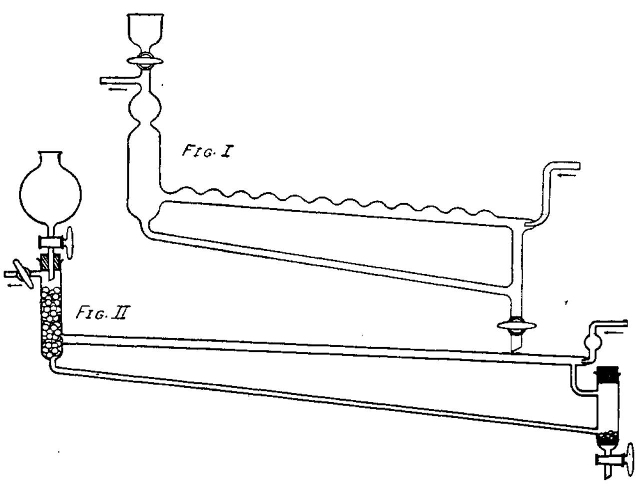
The three forms of gas-washing apparatus illustrated, although involving no new principles, are believed to be somewhat novel in form and they have given such satisfactory service that a description of them may be of interest to other chemists, especially as showing the arrangement of the parts for various uses.[2]

Two of the forms permit a filter to be placed within the apparatus by means of which a precipitate may be separated and washed without exposure to the air. This feature, in a simple and efficient gas wash bottle, is believed to be new and has been found useful for various purposes.

All of the forms illustrated possess the following advantages:

1—They give thorough washing by keeping the gas in contact with the liquid for a long time and yet they



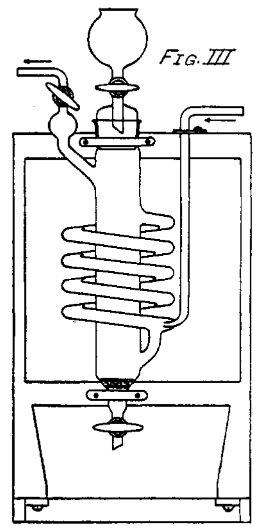
require but a comparatively small pressure for their operation.

2—They provide very efficient circulation of the absorbing liquid, which prevents the saturation of one portion of the liquid while another portion remains unsaturated.

3—They can be filled or emptied without disconnecting, and, indeed while in use if the tube for introducing the reagent is arranged as shown in Figs. II and III.

The apparatus illustrated in Fig. I is designed to thoroughly wash a stream of gas with a minimum amount of liquid and with the lowest possible operating pressure. The series of bulbs blown along the top of the absorption tube aid the absorption by prolonging the time of contact between gas and reagent, but do not prevent the apparatus from draining completely. The construction is so simple that the apparatus may be readily made up from glass tubing.

Fig. II illustrates a simple washing apparatus designed for the precipitation and determination of acetylene or carbon dioxide, the precipitate being filtered off and washed without exposure to the air. A Witt plate and asbestos filter at the drain cock are covered with a layer of glass beads or another Witt plate to prevent the filter being loosened by the circulation of the liquid. The beads near the outlet serve to break up the gas bubbles and prevent loss of liquid, as well as furnish additional surface. When the absorption is complete, the stopcock on the outlet is closed, the stopcock below the filter opened, and the filtration allowed to proceed under the pressure of the inflowing gas; suction can be used if desired. Washing is accomplished by introducing wash water through the funnel tube near the gas outlet, the liquid being forced through the filter by gas pressure as before. A straight absorption tube is used instead of the bulb tube shown in Fig. I because of the difficulty of washing a precipitate clinging to the bulbs.



A helical wash bottle, Fig. III, is the same in principle and operation as No. II but has been designed with a view to economy of space. This apparatus is very compact and efficient, giving as complete absorption as several ordinary wash bottles in series, while requiring only a small fraction of the pressure necessary to operate the latter. With gas flowing at the rate of 100 cc. per minute the bubbles remain in the helix about seven seconds. Bubbles passing at the rate of one or two per second remain in the tube nearly twenty seconds. Gas passed at the rate of 500 cc. per minute is still broken into fairly small bubbles and receives a very thorough washing, but if the gas is to be passed at a more rapid rate than this the helix should be made of tubing of larger diameter. This form of apparatus is much easier to make than, and quite as efficient as some of the more elaborate apparatus on the market in which the gas bubbles follow a helical path. It possesses the additional advantage of permitting the filtration and washing of a precipitate within the apparatus without exposure to the air.

For satisfactory operation, it is necessary that the diameter of the absorption tube in all three forms be properly proportioned to the rate of gas passage. This tube should not be made too small. A tube

1 Published by permission of the Director, Bureau of Standards.

2 See also Cumming, *Chem. News*, **101** (1910), 39; J. D. Edwards, This Journal, **6** (1914), 468; Purves (Gray's apparatus), *Gas World*, **60** (1914), 897.

with an internal diameter of 8 to 10 mm. was found to work very satisfactorily at rates of less than 500 cc. per minute. The tip of the inlet tube has an internal diameter of 1 to 2 mm. The size of the other parts of the apparatus will depend primarily on the amount of reagent, and the duration of contact between gas and reagent, which is desired.

BUREAU OF STANDARDS, WASHINGTON, D. C.

ADDRESSES

SOME PROBLEMS OF CHEMICAL INDUSTRY[1]

By RAYMOND F. BACON[2]

The industrial researcher, who deals with the processes of manufacture and the phenomena of reactions involved, is becoming less and less regarded as a burden unwarranted by returns. The aim of every industrial operation is toward perfection, both in process and the necessary mechanical equipment, and every new development in manufacturing creates new problems. It follows, then, that the greater the number of researches, the greater is the progress in a given field, and the greater becomes the number of new problems. Moreover, one can only conclude that, since perfection is but, after all, an ideal, no industrial field has been sufficiently investigated.

The thirst for distinction and wealth kindles the lamp of invention, and the light of the knowledge resulting from discoveries and improvements in manufacturing operations has so emboldened us that some industries now consider themselves capable of solving any problem. This has been shown in innumerable instances, but is particularly true of the great chemical industry, which, while its achievements have been stupendous, is nevertheless confronted with many problems of importance. With your permission, I shall restrict myself to recounting some of the problems which engage the attention of the present-day chemical industrialist—problems which he is capable of clearing up, provided the service of research is called to his aid, but which have so far remained unsolved. In collating these I have drawn from all available resources of information and from my own experience.

SOME METALLURGICAL PROBLEMS OF TODAY

While there may not be at the present time room for such abnormal discoveries in siderurgy as in the past, investigators are quietly and steadily augmenting our knowledge of iron and its alloys, and the value of such research work is generally recognized. Elaborate investigations are constantly being conducted by several manufacturers, especially by the United States Steel Corporation, which has to date expended over $800,000 in studies on the electrothermic production of steel alone. However, metallurgical research laboratories are still comparatively uncommon. Very few iron furnaces or smelting plants are without a control laboratory, which has come about notwithstanding the opposition of "practical men," and the research laboratory will eventually win a similar victory. Such problems as the working-up of blast furnace slags by an economic process could probably be solved by systematic research.

The great problems at present in the metallurgy of zinc are in concentration of the ore and in the treatment of flotation concentrate. The latter produces the troubles that fine ore always does; it is difficult to roast, and the distillation of it is attended with troubles. Viewing the present status of the practice in zinc smelting, one is impressed by the high extraction results, the low fuel consumption made possible by regenerative gas-firing, and the reduction of labor involved in the art.

In copper metallurgy, the leaching of copper ores and electrolytic deposition for precipitating are receiving increased attention. With regard to chemical precipitation, it is desirable that this process be conducted in such a way as to regenerate the solution. In electrolytic copper refining, promising progress has been made in the treatment of anode slimes, and increasing attention is being paid to the recovery of by-products. Then, too, the progress in the development of flotation processes has been phenomenal, but still our knowledge regarding flotation is meager.

The search for platinum substitutes continues, and an economic method for rapidly separating the metals of the platinum group is also desired.

The brass industry has been carried on for more than a century in Connecticut and considerable study has been given the matter of zinc loss, but so far ones engaged in the industry have been unable to find any economic and entirely satisfactory method to overcome such loss. Moreover, no entirely satisfactory gas furnace has been designed for general brass rolling mill practice.

The development in engineering construction has arrived at a point where the use of special alloys for specific requirements requires more thorough investigation. The matter of corrosion has been one of a more or less mysterious nature; confusion has arisen on account of the names of alloys; the ideal alloy for condenser tubes has not been found; the failures of screens made from brass wire are well known, and we have yet to find an aluminum alloy that will resist alkalies. It is true that there is beginning to be a well-defined literature on the subject of alloys and that now one can sometimes very closely predict the properties of combinations of the more commonly known metals; but we have not begun to open up the possibilities of usefulness in the exploration of the alloy field, in which I include the so-called "dilute alloys"—cases wherein a very small amount of a metal alloyed with, say, iron or steel confers upon it some new or unusual properties.

SOME PROBLEMS OF INDUSTRIAL INORGANIC CHEMISTRY

Nitrous oxide is being successfully used in combination with oxygen for the production of anesthesia; but while there is a material available for the production of oxygen upon treatment with water ("oxone"), no substance which will yield nitrous oxide upon similar treatment is known. On account of the present large consumption of nitrous oxide, considerable study has been devoted to this problem.

New uses, ones such as would increase the demand, for the following products are required: Potassium hydroxide, chlorine, bleaching powder, bromine and bromides, calcium, silicon, selenium, tellurium, cobalt, uranium and molybdenum. Since sodium metantimonate is undesirable in enamels placed on cooking utensils, new uses for this and other antimony compounds are needed; attention may be directed to the fact that antimony lithopones, made by treating barium carbonate and antimony sulfite, offer, perhaps, a partial solution of this problem. It may be noted here that a large production of arsenic would follow a demand.

In the domain of ceramics, the subject of binders presents a field for research; to cite a simple instance, a binder for infusorial earth that is cheap and will stand a temperature of about 3,000° F. is being sought for by ones interested in the production of metallurgical brick.

Efforts to improve the quality of all varieties of clay goods, from ordinary brick to the highest-grade pottery, are constantly in progress by American clay-workers; this is evinced by the new

[1] Author's abstract of an address delivered before the Chicago Section of the American Chemical Society on May 14, 1915. In Dr. Bacon's absence, this address was presented by Dr. S. R. Scholes, Assistant Director of the Mellon Institute.

[2] Director of the Mellon Institute of Industrial Research and School of Specific Industries of the University of Pittsburgh.