

structional staffs from among their own graduates. Many of the smaller colleges cannot afford to pay the salary required to get a graduate of another institution. It is necessary for them to capitalize the loyalty and inertia of their own graduates. This practice, however, is not confined to the smaller colleges. The assignable reason for its practice by the larger institutions would seem to be the high esteem with which they regard their graduates. An interesting example of this is a certain well-known institution on the eastern seaboard. Its chemistry faculty consists of eight members, one of whom is emeritus. Of the remaining seven, all received at least a substantial portion of their education at that institution. Such a practice, if continued, can but lead to a narrowing of the mental vision of its instructional staff.

The war brought women chemists to the front. Heretofore, women have studied chemistry much as they studied astronomy, for the pure pleasure of the study itself. With their entrance into the industrial world an additional viewpoint must be acquired, namely, that of making themselves valuable as chemists to their employers. Industrially and in governmental service women appear to be particularly adaptable as analytical chemists. Yet it is a fact that the majority of women's colleges emphasize quantitative analysis to a lesser degree in their curriculum than any other branch of chemistry.

The high cost of print paper has not been without its advantages. It has tended to eliminate an undesirable custom practiced by a number of our institutions. The evil referred to is that of padding the catalogues. Certain institutions seem to vie with one another in the bulk, offerings, and gorgeousness of their catalogues. The chemistry sections of these catalogues are not free from this vice. Courses are announced and described in the catalogues of certain institutions which require special and extended physical and chemical equipment and instructors trained along these special branches of chemistry. The size of the institution, its assets and income indicate that it has no such equipment. Its catalogue shows no instructor qualified to handle the course. And yet it is announced as being offered. This practice should be stopped. Such a catalogue fools no one but its authors, the student victims, and the parents of the latter.

Most educators have devoted thought to the problem of the relative time to be allotted in a curriculum to each of the various courses of chemistry. No argument is needed to sustain the assertion that all branches do not require the same amount of time. Yet in probably 40 per cent of our institutions the mechanical arrangement of the institution's semester schedule will determine the time to be allotted to the study of a particular branch of chemistry. Some instructors are partial to three-hour courses, some to four, and some to five. For instance, one institution coming under survey gives six credits of general and inorganic, six of qualitative, six of quantitative, six of organic, and six of physical. The writer is advocating no special scheme of time allotment. This must depend on the judgment of the individual instructors, on the purpose for which the course is offered, and on the equipment and library facilities available. But such a course as that outlined above shows the entire lack of appreciation of the time element in outlining a curriculum. Mechanical convenience of the schedule should be among the less important factors taken into consideration.

During the course of the investigation, the above interesting facts regarding the chemistry departments of our institutions came to light. The writer is not in a critical mood and the above suggestions are made because it is felt that they will be welcomed as an aid in the solution of the reconstruction problems now before the chemistry departments of colleges and universities.

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BIBLIOGRAPHY ON THE USE OF "CUPFERRON" AS A QUANTITATIVE REAGENT

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From a survey of the standard texts on analytical chemistry it seems that "cupferron," the ammonium salt of nitrosophenylhydroxylamine, has not been given due consideration as a quantitative reagent. From the results obtained by various investigators, it should be a reagent of exceptional value as a selective precipitant. It is my purpose here to call attention only to the many uses for which it may be employed and give a complete bibliography of the work that has been carried out on the subject.

O. Baudisch¹ first suggested the use of "cupferron" for the separation of copper and iron. He shows that iron is quantitatively precipitated by "cupferron" from strongly acid solutions, while copper is not precipitated under the same conditions. On the other hand, copper and iron are both precipitated from slightly acid solutions while nickel is not, thus affording a separation of copper from iron when present together and of iron and copper from nickel when all three are present. Again the copper salt is soluble in concentrated ammonia solution, thereby making an easy separation of copper from iron when both are precipitated together. Baudisch and King² state that the precipitate of iron thus obtained settles rapidly and is easy to handle. It is soluble in ether, chloroform, and acetone, and thus can be dissolved away from lead, silver, mercury, and tin if they should in any manner contaminate the precipitate.

Biltz and Hödke,³ Hanus and Soukup,⁴ and R. Fresenius⁵ have carried out more extensive investigations showing that not only is this separation very clean-cut in the case of copper and iron from nickel but they may also be separated from solutions containing aluminum, chromium, cobalt, zinc, alkaline earths, and manganese. The iron may also be separated from lead and bismuth in addition to those metals already mentioned. With the present increasing number of alloys having as their chief constituents the elements just named it seems that this reagent should greatly facilitate the ease and rapidity of their analysis.

Bellucci and Grassi,⁶ and Thornton⁷ find that from solutions acid with hydrochloric or sulfuric acids titanium is precipitated as well as iron, thus giving a method for the separation of titanium and aluminum and at the same time making a determination of the titanium, as its salt can be directly ignited to the oxide (TiO₂). Thornton⁸ has also extensively investigated the use of "cupferron" for the separation of zirconium and thorium from iron and has apparently obtained satisfactory results.

James Brown⁹ by using the data of previous workers together with that of his own on zirconium has made an excellent separation of iron, titanium, and zirconium from manganese and aluminum. His data show that great accuracy is possible in a determination of this kind. He precipitates the iron, titanium, and zirconium from cold solutions containing 25 cc. of sulfuric acid (1 : 1) in 150 cc. of solution. He analyzed the filtrate containing the manganese and aluminum by the ordinary methods and treated the precipitate in the following manner: It was ignited to give the combined oxides, these were taken into solution, and the iron precipitated with hydrogen sulfide in the

¹ *Chem.-Ztg.*, **33** (1909), 1298-1300; *J. Chem. Soc.*, [Aii] **1910**, 76-77.

² *THIS JOURNAL*, **3** (1911), 629; *Chem. Abs.*, **5** (1911), 3780.

³ *Z. anorg. Chem.*, **66** (1910), 426-31; *J. Chem. Soc.*, [Aii] **1910**, 550.

⁴ *Z. anorg. Chem.*, **68** (1910), 52-56; *J. Chem. Soc.*, [Aii] **1910**, 899.

⁵ *Z. anal. Chem.*, **50** (1911), 35-43; *J. Chem. Soc.*, [Aii] **1911**, 336.

⁶ *Atti accad. Lincei*, [5] **22** (1913), 30-34; *J. Chem. Soc.*, [Aii] **1913**, 250; *Chem. Abs.*, **7** (1913), 1688.

⁷ *Am. J. Sci.*, [4] **37** (1914), 173-8; *J. Chem. Soc.*, [Aii] **1914**, 299; *Chem. News*, **114** (1916), 13.

⁸ *Am. J. Sci.*, **37** (1914), 407; **38** (1914), 137.

⁹ *J. Am. Chem. Soc.*, **39** (1917), 2358-66; *Chem. Abs.*, **11** (1917), 3190.

presence of tartaric acid. The titanium and zirconium were then separated by ordinary methods. Excellent results were obtained in solutions containing varying amounts of the elements between the following limits: Fe_2O_3 , 0.0859–0.1789 g.; ZrO_2 , 0.1130–0.2159 g.; TiO_2 , 0.0542–0.0050 g.; Al_2O_3 , 0.1043–0.1135 g.; MnO_2 , 0.1254–0.0051 g. From the results obtained it would seem that this procedure could easily be applied to the R_2O_3 precipitate in a clay analysis.

Turner¹ and Rodeja² have determined vanadium in a similar manner and obtained successful separations of it from AsO_4^{--}

¹ *Am. J. Sci.*, [4] **41** (1916), 339–43; **42** (1916), 109–10; *J. Chem. Soc.*, [Aii] **1916**, 347, 540; *Chem. News*, **114** (1916), 261.

² *Anal. soc. espan. fis. quim.*, **12** (1914), 379–82; *Chem. Abs.*, **9** (1915), 2202; *Anal. soc. espan. fis. quim.*, **12** (1914), 305–9.

and PO_4^{--} as well as from uranium in strongly acid solutions. However, Turner seems to take exception to Rodeja's method of procedure.

Wissenson¹ has successfully used this reagent to determine the iron in potassium ferrocyanide and Schroeder² gives some additional data for the separation of iron from cobalt and nickel. However, these two papers seem rather unimportant, but the references are given to complete the bibliography.

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¹ *Z. angew. Chem.*, **23** (1911), 969; *Chem. Abs.*, **5** (1911), 3024.

² *Z. anorg. Chem.*, **72** (1911), 94.

SYMPOSIUM ON REFRACTORIES

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THE WORK OF THE TECHNICAL DIVISION OF THE REFRACTORIES MANUFACTURERS' ASSOCIATION

By R. M. HOWE

In May 1917, the Refractories Manufacturers' Association entered into an agreement with the Mellon Institute of Industrial Research of the University of Pittsburgh, whereby research work was to be conducted at that institution for the benefit of the refractories industry. The incumbent of this multiple industrial fellowship was not, however, available for other than urgent work, and consequently a plan was formulated in accordance with which company members that maintained no laboratories, and a few that did, could have constant access to this central laboratory devoted to the refractories industry for obtaining analyses on and advice respecting ceramic materials. This was equipped with the necessary apparatus for making physical and chemical tests and for the experimental manufacture of fire brick.

The problems of the refractories industry are numerous indeed, and hence the personnel of the research staff increased from one to five in a very short time. Experimental work was done for over fifty companies during the first year, and, as a result, little time was available for general research on account of the demands for individual service. These requirements were undoubtedly due to the fact that the laboratory was made self-supporting, yet was not operated for profit. The only restrictions made were to prevent the possible monopoly of the staff by any one company.

The problems which are most frequently encountered can be best illustrated by following the raw material from the mine to the kiln. Since many excellent articles on the manufacture of silica and magnesite brick have been published, this paper will be limited to refractories made from fire clay.

The characteristics of this material vary considerably, not only in different districts but in different deposits of the same district, and in different sections of the same deposit. This variation concerns the chemical composition, refractoriness, hardness, color, plasticity, and other general characteristics of fire clay. In addition to this, it is sometimes discovered that flint clay deposits, which are believed to be extensive, are exhausted quickly, and that land supposed to cover flint clay covers none.

It is the former condition that makes it essential for a miner to know each piece of clay as it is encountered, and to be able to accept or reject it according to that knowledge. It is the latter condition which explains why plants are sometimes located at what is now known to be a disadvantage. Both conditions explain how necessary it is to have complete data available as to the extensiveness and quality of a deposit. Accordingly, the practice of securing drill cores is growing and these are

tested thoroughly. Such tests give the requisite information, and make it possible to recognize the good and bad material by visual methods.

It is remarkable that most of these systematic studies reveal the fact that good clay is being rejected or left in the mine because of a difference in color, hardness, or structure. Less often undesirable clay is used.

The clay, after being mined and sorted, is taken to a crusher, where it is again sorted and reduced to a workable size. It is later mixed, ground, and tempered with water prior to being shaped. Since different plants follow different practices in preparing the clay for shaping, it is necessary to consider blending, grinding, and tempering separately, although these three operations are often conducted simultaneously.

While many clays are used alone in the manufacture of fire brick, in most cases mixtures or blends are employed because these have more desirable properties than are generally found in any one clay. Hence crushed fire-brick bats and plastic clays are blended for manufacturing a strong, refractory product of low shrinkage. Raw or calcined flint clay often displaces the bats; silica is sometimes added to open the structure and hence increase the resistance to spalling; while bauxite raises the softening point. In other cases, clays are blended so as to secure a greater capacity from the available materials.

After these materials have been mixed, they are ground together and in this process many of the final properties of the fire brick are imparted. The coarser grinds are generally used in producing open, porous roof brick, etc., while finer grinds are used in making dense slag and abrasion-resisting products.

Naturally, fusion, slag penetration, spalling, abrasion, and reheating tests are all of value in judging how well certain grinds and mixes will meet the requirements of usage.

Tempering also exerts a very important influence in determining the final characteristics of a fire brick. This term, which is broad, covers the addition of large or small amounts of water, working for different periods of time, and the application of slight or heavy pressure during working.

TABLE I

Water Per cent	Porosity Per cent	Modulus of Rupture	Same after 20 Immer- sions from 1300° C. into Cold Water	Relative Strength of Briquettes after Immersion Per cent	Working Consistency
7.5	24.0	2491	804	32.1	Very stiff mud
9.0	20.3	6019	2776	46.2	Stiff mud
10.0	20.6	4020	3298	82.1	Soft mud

The figures of Table I illustrate very clearly how different amounts of water affect the structure of fire brick. In securing these data, a large batch of clays was made up with different amounts of water and then pressed into briquettes. These were burned and tested (Fig. 1).