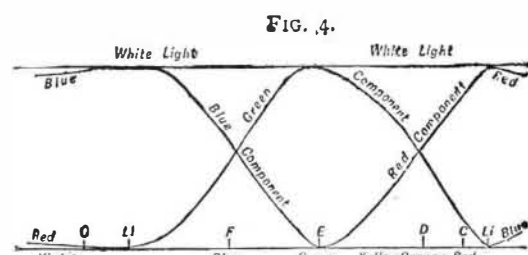


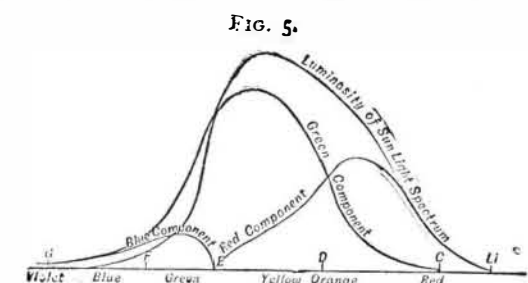
the direct light also shows itself in the reflected light. Instead of gas light, reflected sky light, the electric light, or sun light can be employed by very obvious artifices, in some cases a gas light taking the place of the reflected beam.

It will be in your recollection that I said that the color of an object depended on the eye of the observer. Vision, I have told you, depends on the fact that three color sensations are necessary for the normal eye to see white light. There are, in fact, as I have said, three sets of nerves, one responding to the blue, one to the green, and one to the red.



If one of these sensations be absent, then the eye does not see white light as we know it, but as—what would to us be—colored light. The above diagram shows the three sensations as determined by Clerk-Maxwell. The top line is supposed to be the spectrum as the eye sees it, all colors being of equal value. It will be noticed that at only three places in the spectrum is the color pure, and all intermediate colors are made up by mixtures of two sensations, the height of the curves added together giving the height of the straight line parallel to the base of the curve.

Now, in order to test the eye for color blindness, it is only necessary to get a person so afflicted to measure the luminosity of the spectrum. For evidently, if deficient (say) in red sensation, the spectrum would begin where the green color sensation commences, and even then the luminosity would be much smaller, owing to the absence of such red sensation. Such a luminosity curve is seen in Fig. 5, and in the same figure is shown



the color deficiency. It is comparatively easy to show the color of the light which color-blind people see. If a certain proportion of the light near the position which the blue lithium line occupies in spectrum be mixed with a certain proportion of the green light of the spectrum near E, and the two be combined in a patch, the color of the patch will be that seen by a red color-blind person. [This was shown on the screen, and the vermilion, emerald green, ultramarine, and gamboge were placed in the mixed light, and the alteration in color of the pigments noted.] In the same way the white light which blue and green color-blind see can be shown.

In measuring the luminosity of the spectrum, you cannot but have noticed that the shadow illuminated by the white light never appeared as white, but always colored. Thus, when placed in juxtaposition with the yellow, the shadow illuminated by the white light appeared bluish; when with the green, reddish; and when with the blue, yellowish. The color given to the shadows illuminated by the white light is merely the effect of contrast, and is due to error of judgment by the eye. The tendency of white in proximity to a color is to make it to appear of the hue of the complementary color, to which I shall draw attention in my next lecture.

(To be continued.)

ANALYSIS OF "TOBACCO SCREENINGS" REJECTED IN THE MANUFACTURE OF TOBACCO.

By L. P. BROWN.

THIS material consists of the small fragments of stems and leaves which with the dust are sifted from tobacco after it has been ground, in the process of preparing smoking tobacco.

Much of this substance is mixed in certain manufactured fertilizers, and is not unfrequently applied directly as a top-dressing to grass, etc.

The sample examined was taken from a lot of the screenings shipped from Lynchburg, and afforded the following:

Water lost at 100° C.....	10.27
Total (crude) ash	43.40
Organic matter (by difference).....	46.33

100.00

IN THE ORGANIC MATTER.

Nicotine.....	0.36
Albumenoids and nitrates.....	6.96
(Total nitrogen) equivalent to ammonia.....	1.48

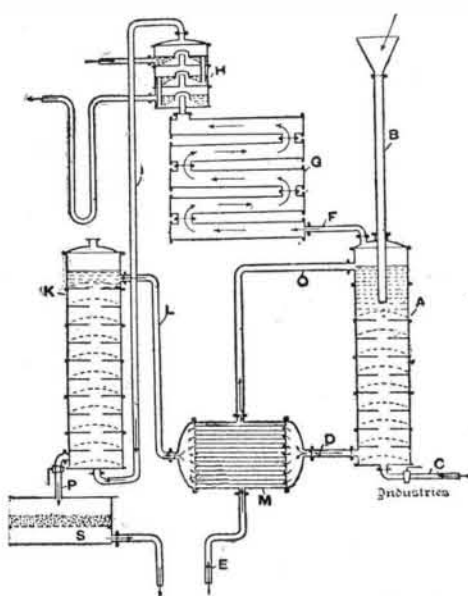
Constituents of the ash :	In 100 Parts of Screenings.	In 100 Parts of Ash.
K ₂ O.....	1.187	2.89
Na ₂ O.....	0.506	1.23
CaO	2.796	6.81
MgO	0.346	0.84
Al ₂ O ₃	0.192	0.47
Fe ₂ O ₃	0.212	0.52
SiO ₂	33.760	82.32
P ₂ O ₅	0.296	0.72
SO ₃	0.483	1.14
Cl.....	0.451	1.10
SiO ₂ , soluble.....	0.907	2.21
Deduct O, equiv. to Cl.....	0.25
	41.186	100.00

In estimating the value of this substance as a fertilizer, we must consider the nicotine, which acts as an insecticide, in addition to the organic matter and the plant food ingredients. As to the latter and the nitrogen, there is contained in 2,000 pounds, reckoning at present commercial prices, potash, phosphoric acid, and nitrogen to the value of six dollars.—*Amer. Chem. Jour.*

BICARBONATE OF SODA.

E. SOLVAY, Brussels.

IN the manufacture of bicarbonate of soda by the ammonia process, it is difficult to prevent the bicarbonate from being intermixed with a certain amount of ammonia. The inventor has designed an improved method and apparatus for removing this and other impurities in the bicarbonate. The crude chemical is dissolved by means of steam, and the solution is heated to the temperature of 35° C. The result of the heat is that the ammonia and carbonic acid is evaporated, and a pure solution of carbonate of soda is left behind. The gaseous distillate is conveyed to a chamber where the ammonia is deposited and the carbonic acid purified, and the latter is afterward forced through the cooled solution of carbonate. In this way the same carbonic acid is taken up again to form bicarbonate. The apparatus which is employed is illustrated in the accompanying figure. The crude bicarbonate is introduced through the inlet, B, into the vessel, A, and the steam



is allowed access through the pipe, C. Another inlet is provided at O, for the entrance of water or of mother liquor containing impure bicarbonate, which is to be treated in the same way. The gases which are evolved by the decomposition of the bicarbonate are led through the pipe, F, to a refrigerator, G, and afterward to the washing apparatus, H. The purified gases proceed along the pipe, I, to the bottom of the cylinder, K. The liquor which remains in the chamber, A, is sent through the pipe, D, to a refrigerator, M, where it is cooled by the action of the entering stream of water or mother liquor which passes through the pipes, E, O. The cooled solution of carbonate is passed into the upper end of the cylinder, K, where it is treated with the purified carbonic acid, and transformed by it into bicarbonate again. The bicarbonate which is thus formed is drawn off through the pipe and sent through the filter, S. The bicarbonate is deposited in this tank, and the mother liquor finds its way out, to be used for the same purpose in future operations.

RECOVERY OF AMMONIA AND CHLORINE IN THE AMMONIA SODA PROCESS.*

By FRED. BALE.

WHEN ammonium chloride is volatilized, and the vapor passed over or through heated metallic oxides at a temperature of about 400° C., 25 to 50 per cent. of the ammonia evolved is decomposed. If, however, the ammonium chloride be intimately mixed in powder with powdered oxide of manganese, on heating the ammonia is gradually and completely evolved at a temperature of 130° C. to 325° C., without the loss mentioned above after the evolution of the ammonia.

Cold or dry air can be drawn over the heated residue, which can in this way be entirely freed from any moisture or undecomposed ammonium chloride. Air may also be passed through the retort throughout the whole operation, and thus prevent any leakage, and at the same time reduce the decomposition to a minimum. Nickel oxide, when substituted for oxide of manganese, causes the ammonia to be freely given off at about 325° C., and after the passage of the air chlorine comes off at about 500° C. Other oxides require a much higher temperature for the evolution of the chlorine.

The percentage yield of chlorine is (with few exceptions) about one and a half times as great when a peroxide is used as when a monoxide is used at the same temperature. The sesquioxides yield, as a rule, about one-third less ammonia than would be expected from theoretical considerations, the remaining third being resolved into nitrogen and hydrogen. Oxides which by this process are converted into sesquioxides may, by reduction with charcoal or small coal, be obtained in a form which will then give the same equivalent of ammonia as at first.

The author proposes to use this process in connection with the ammonia soda method for preparing bicarbonate of soda, and thus prevent the loss of chlorine as chloride of calcium, which has little commercial value. He is also of opinion that there would be a large saving of labor and fuel in the manufacture of ammonia. He claims by his method of mixing the oxide or oxides with the ammonium chloride the advantage of being able to readily expel the whole of the ammonia present at a low temperature.

* Abstracts of papers—British Association for the Advancement of Science.

It differs also in the movable character of the oxide or oxides used, and the low temperatures employed throughout, and in the use of atmospheric air for the expulsion of the ammonia and steam from the retort. Trimanganic tetroxide, or any other oxide of manganese except the sesquioxide, or magnesia, or a mixture of these two, seem to give the best results. An ordinary Stourbridge fire clay retort is employed. It is important for the successful carrying out of the process that the temperature of the retort be increased gradually, and as soon as the evolution of ammonia has ceased, there is a distinct pause in the reaction. It is also essential that the moisture be removed by the passage of dry cold air over the heated residue before the chlorine, which is subsequently evolved, is led into the bleaching powder chambers.

The chlorine is evolved as soon as the temperature is raised to a dull red heat, and dry air is substituted for the cold air. If the air be carefully passed, chlorine to the extent of 9 to 12 per cent. of the issuing gases is evolved when manganese is the oxide used. The residue, after all the chlorine has been evolved, is practically equivalent when reduced to the oxide originally used, and can be used for a subsequent charge, making the process a continuous one. It is necessary, however, for this residue to be removed from the retort at intervals of about a week, and washed with common salt if that body is present in the ammonium chloride.

Except for this impurity, the retort need not be opened, as the ammonium chloride is thrown in at the mouth of the retort and mixed at once with the oxide by shutting the door of the furnace and causing the scarpier to revolve. If the retort be heated by a self-feeding and practically automatic coke furnace, with properly arranged flues, the initial temperature can be obtained by the workman placing a mercurial thermometer through the door of the retort from time to time. The proportion of sal-ammoniac to oxide which is found to give the best yield is one of the former to four of the latter. This composition of the mixture insures the complete decomposition of the chlorides or oxychlorides, and also prevents any fusion of the chlorides or caking of the retorts.

Besides the oxides above named, other heavy oxides and oxides of the alkaline earth metals may sometimes be used with advantage. The salts of these oxides have also been used with satisfactory results, and also the different varieties of clay when purified from iron.

Of these substitutes, cobalt oxide alone, or mixed with magnesia, appears to be the best in giving the equivalent of ammonia, and in the ease and low temperature at which the chlorine is evolved. Magnesia reacts somewhat on the retort when one of fire clay is used. Cobalt chloride is also slightly volatile, while nickel oxide requires a higher temperature for the evolution of the gases, although it has the advantage of existing as a monoxide at a high temperature, and therefore needs no subsequent reduction.

The manganese oxide, and also some of the other oxides above mentioned, after several operations, become oxidized to sesquioxide, and thus cause a loss of ammonia if not reduced by coal. The reduction is effected by shutting off the air supply, and adding small coal to the extent of about one-fiftieth the weight of the oxides used. The gases from a coke furnace may also be passed over the residue when it is more convenient to effect the reduction by their use.

The fire clay retorts which Mr. Bale recommends are of special manufacture, and are made sufficiently non-porous to prevent the ammonia passing through them into the fire. They are worked in series, and are connected with a supply of air, which is drawn through them by an exhauster during the evolution of the ammonia, and by a blower when the chlorine is evolved. In order to control the temperature as far as possible, the retorts are heated either by coal gas or, as mentioned above, by a self-feeding coke furnace.

The retorts are set horizontally, and are fitted with covers at each end, with pipes for the passage of the gases. In the preparation of bleaching powder with the dilute chlorine, the author has found that the action on the lime is sufficiently energetic, while at the same time the temperature does not appreciably rise.

The disadvantages arising from the use of ammonium chloride containing small quantities of sodium chloride on a large scale are obviated by previously subliming the salt, the additional expense of this operation being more than compensated by the several advantages gained.

PROPOSED INTERNATIONAL STANDARDS TO CONTROL THE ANALYSIS OF IRON AND STEEL.

By Professor JOHN W. LANGLEY, University of Michigan, U. S. A.

IT is well known that the results of chemical analysis will differ slightly with the methods employed and with the personal peculiarities of the operator. This latter has been called the "personal equation" of the analyst.

These causes of variation are of great importance in all investigations where minute quantities of foreign bodies have to be sought in large amounts of a compound or mixture such as all samples of commercial iron and steel. In this class of analyses, the percentages of carbon and phosphorus are often as low as 0.15 per cent. and 0.01 per cent. respectively, and yet these small amounts will have quite marked effects in the steel which contains them.

In order to bring about a greater uniformity of analyses in the countries which are the principal producers and users of iron and steel, it is proposed to prepare a quantity of samples which shall be absolutely identical, and to distribute them to properly qualified analysts in those countries, who will then analyze them and will interchange reports of their results with each other.

By the above plan, there will be in each country participating in the work a quantity of metal identical with that in the other countries, and which has been analyzed with the utmost care by a considerable body of chemists, so that its composition may be said to be known authoritatively and beyond dispute, and which will thus constitute international standards.

The standards so obtained should serve two important purposes. First, they would show, in the course of their preparation, the relative agreement in the