NOTES ON CHEMISTRY.

READ BEFORE THE NEW YORK ACADEMY OF SCIENCES, APRIL 10, 1876, BY PROFESSOR ALBERT R. LEEDS

ON UNUSUAL OCCURRENCES OF PHOSPHORIC ACID.

1. In commercial soda ash: in notable quantity. As this is used as a flux, the occurrence of phosphoric acid might, in certain cases, produce unlooked-for results. Its presence would, moreover, as a general rule, be detrimental.

2. In fluorite: shown to be present in American fluors, more especially those from Southern Illinois. According to Berzelius, the spar from Derbyshire contains 0·5 per cent of phosphoric acid. No analyses of American fluorites appear to have been recorded. When they are performed, the determination of the percentage of phosphoric acid should form not the least important feature of the analysis, and should be made with extreme care.

3. In cryolite: the mineral analysed came from Evigtok, Greenland, and every care was taken to select out pure material, free from the minerals usually occurring in connection with the cryolite.

4. In artificial fluor spar, patented under the name Stevens flux: It is made by heating cryolite with lime, and washing out the fluoride of calcium thus formed. A quantitative determination gave 0·00934 per cent of phosphorus, corresponding to 0·0214 per cent phosphoric acid.

5. In the so-called chemically pure sulphuric acid: in the course of the preceding analysis it was necessary to use a large amount of sulphuric acid in order to get the minerals into solution. Although it seemed an almost absurd precaution to look for phosphoric acid in the sulphuric acid, yet it was done, with the result of finding some actually present. The acid analysed was that which has been used at the Institute for several years with great satisfaction. That portion of the acid used in the preceding analysis contained 0·0006 per cent of phosphoric acid.

On other probably occurrences of phosphoric acid: It is worthy of note that cryolite is one of a class of minerals, similar in their constitution and in their rock associations. Thus cryolite, 3 Na F + $Al_2 F_3$, occurs at Evigtok in gneiss, chiolite, 3 Na F + 2 $Al_2 F_3$, in the Ilmen Mountains in granite, associated with topaz, fluorite, and cryolite. Examination, more critical than that to which they have been subjected, would probably reveal the presence of phosphoric acid in a number of similar fluorine-holding minerals.

A converse proposition is probably true of minerals containing phosphoric acid. In quite a number of instances this is the fact, as in amblygonite, wagnerite, and apatite. The associations of these three minerals are likewise very similar. There is an interesting field of study open regarding the mineral combinations in which phosphoric acid, chlorine, and fluorine enter in combination with alkaline bases, and earths. By artificial means, the number could probably be largely increased. Finally, many silicates deserve re-examination. The minerals chondrodite, topaz, and muscovite are similar in containing fluorine and in their associated rocks, the first occurring in granular limestone, the second in gneiss or granite, the last forming a constituent portion of gneiss. It is doubtful whether these and similar silicates have ever been examined for phosphoric acid, with the aid of the refined qualitative tests of late years perfected for this substance.

Over great areas of metamorphic rocks, the soil produced by rock decay retains an inexhaustible fertility, and every soil analysis shows the presence of a considerable percentage of phosphoric acid. In the case of the gneiss rocks of the Atlantic States, this phosphoric acid is not improbably derived in part from an undetected trace of phosphoric acid in the muscovites.

That these surmises should not appear unwarrantable, it should be borne in mind: 1. That in the great majority of cases, phosphoric acid has never been looked for. 2. That it is only of late years that chemists possessed a ready method of detecting it, and an accurate method for its quantitative estimation. 3. It might frequently be precipitated in combination with certain bases, and the fact be readily overlooked.

A RAPID METHOD OF DOUBLE WEIGHING.

In the weighing of the two portions required for the analysis in duplicate of a substance, the following device, which, if not new, is new at least to the writer, will be found materially to shorten the time required: Equal portions, as nearly as the eye can judge, say (in the case of a carbon determination in steel) about 5 grammes (75 grains), are placed in the two watch glasses of the balance. They are equilibrated by transferring from the heavier side. Each portion is then removed and equilibrium restored by weights; their sum is the weight of both portions. Of course, this is accurately true only when the balance is in perfect adjustment. If not, the following mode of double weighing will give accurate results in the same time as is required to make one double weighing in the ordinary manner. Calling the right hand watch glass R, and the left hand watch glass L, after the two portions are in equilibrium, one (say that in R) is removed, and its place supplied by weights. These are to be taken as the weight, not of the portion in L, but of the portion in R. The portion in L is now to be removed, and the weights by which it is replaced are in like manner to be regarded as the weight of the portion in L.

AVOIDANCE OF ERROR IN WEIGHING ABSORPTION TUBES.

Certain discrepancies having appeared in duplicate determinations, where absorption tubes were employed, and which were assignable to no known error in the method of conducting the analysis, they were attributed in part to the large volume of air displaced, and the variations in temperature and pressure at the successive periods at which the weighings were effected. The absorption apparatus was therefore nearly, but not quite, counterbalanced by a second absorption apparatus of the same displaying capacity and similar glass. The latter was partly filled, and then sealed and kept in the balance case; the former was left in the balance case until the temperatures of both were equal. The amount absorbed was in this way directly measured by the small increment in weights requisite to restore equilibrium. This device has caused the anomalies to disappear, and duplicate determinations rarely differ more than two hundredths of one per cent.

A GENERAL METHOD OF SPECTROSCOPIC EXAMINATION.

A short while ago, Mr. Iles drew attention to the fact that traces of boracic acid could be detected by moistening the borates with glycerin in the application of the spectroscopic test. Mr. Brown Ayres, at the lecturer's request, has applied the same reagent to a number of insoluble and non-volatile compounds of the spectroscopic elements, and finds that a mixture of one part of hydrochloric acid and three parts of glycerin greatly enhances the delicacy and brilliancy of the spectroscopic test. The mixture is applied from a dropping bottle, similar to that used with cobaltic nitrate in blowpipe analysis, and from its adhesive properties may be used with solid particles, and the concentrated residues from evaporation.

EXAMINATION OF AN ARTIFICIAL MINERAL.

This was formed during the casting of an alloy consisting of 85 parts of copper and 15 parts of tin. During the process of casting, a portion of the alloy refused to pour, and was dumped out upon the clean brick floor of the casting room. It was found, on solidifying, that a great number of crystals had formed on the surface and in the cavities exposed to the air. The crystals are needles not exceeding ¼ inch in length and $\frac{1}{250}$ inch in thickness. Luster adamantine, and of great brilliancy. Color, white and transparent. It scratched glass, its hardness being over 6. The specific gravity at 62° Fah., by the bottle, is 6·019. It will be noted that this is lower than the specific gravity of natural cassiterite, which is from 6·4 to 7·1. It glows brilliantly in the oxydizing flame, but gives no evidence of fusion at the terminations of the crystals. It tinges the flame green. With soda, it gives a white coating of oxide of tin. Crystals not apparently affected by several hours' digestion in hydrochloric and nitric acids. In chemical constitution, it is a stannic oxide, containing a small amount of oxide of copper. A quantitative analysis was not made, owing to the small amount at disposal. The mineral is therefore an artificial variety of crystallized stannic oxide or cassiterite.

MUSICAL VIBRATIONS.

LECTURE DELIVERED AT THE STEVENS INSTITUTE OF TECHNOLOGY, BY PROFESSOR C. F. BRACKETT, OF PRINCETON, N. J

The lecturer began by remarking that it was "carrying coal to Newcastle" for him to lecture on musical vibrations in a place where original researches, known and respected even across the water, were made on this subject.

We come in contact with the external world by our senses, and we recognize matter by its effects upon them. All matter presents itself to us by its activities; it is moved by a power which never allows it to rest. If we attach a porous cell to one end of a glass tube and cause the other end to dip in a vessel of water, a jar of hydrogen placed over the porous vessel will gradually cause the passage of the gas it contains into the cell and tube, and will drive out the air before it, which will escape in bubbles through the water. On removing the jar, the inherent activity of the hydrogen impels it to escape again through the pores of the cell, and the water rises in the tube.

By means of a condensing pump we are enabled to force air into a receiver; on turning the stopcock, the inherent activity of the air forces it out again until equilibrium is restored. Conversely, we can withdraw the air from a receiver by means of an exhausting pump; but on opening the stopcock, the activity of the outer air forces it into the receiver until the first conditions are again established. These experiments show that air in its ordinary state, under pressure, and relieved of pressure, possesses inherent activity. In its ordinary state air is under continual pressure, owing to the weight of the atmosphere above it.

A pendulum moved to one side returns to its original position, passes beyond it, and continues to vibrate until stopped by friction and the resistance of the air. Water and alcohol placed in the same vessel in layers, taking care not to mix them, will gradually and completely intermingle by their own inherent activity.

If one end of a wooden rod is fixed in a vise and the other end is bent over, the particles on one side are compressed and those on the other extended. On releasing the end, the particles by their inherent activity recover their original position with such energy as to pass beyond it and the rod continues to vibrate in lessening arcs until it comes to rest. Another form of elasticity was illustrated by means of a rubber tube about ten feet long, of which the Professor held one end and an assistant the other. When this tube was shaken and struck, a series of depressions and elevations were formed, which traveled the whole length of it, like waves, and at one time caused the tube to appear like a series of long links. These vibrations are due, first to the impulse given the tube, and second, to its inherent activity or elasticity. By means of a little manipulation, cords may be made to vibrate as a whole, or in two, three, or more sections: which accounts, as we shall hereafter see, for the wonderful harmony of the pianoforte.

The vibrations of a plate were next exhibited, by covering it with a layer of water and placing it in the vertical lantern. On rubbing the glass with the wet fingers, its vibrations became apparent by the wave motions of the water projected on the screen. The vibrations of a glass tube may be shown by putting some fine powder in it and producing a sound near its mouth, when the powder will arrange itself in little plates, standing on edge and moving to and fro; at certain points, however, the powder remains at rest. These points are called nodal points, and mark the length of the waves. If we had a fork making 1,024 vibrations a second, and a glass tube vibrating in unison with it, the nodal points in the glass tube would be just one foot apart, and would show us that sound traveled about 1,025 feet a second.

Let us now examine how the air is affected by these vibrations. If we suspend a pine rod by the middle and rub the fingers coated with resin over it, it emits a shrill sound. Substituting a brass rod, clamped in the middle and having an ivory ball suspended in contact with one end, for the wooden one, and rubbing it in the same manner, the ball is violently projected from it. The explanation is that all friction acts rhythmically. When one body slides over another, the particles of one seize those of the other and drag them along until the resistance overcomes the attraction between the two; then they return to their former positions, to be again displaced, and these actions recur at regular intervals. Now suppose the rod to be replaced by a tuning fork, and the ivory ball by the particles of air in contact with the fork. These particles are first thrown off, forming a condensation of the air; then they return, forming a rarefaction, and are immediately projected again by the next beat of the fork against them. The condensed and rarefied waves are then propagated outward through the air.

The cross section of a tube contains a great number of air particles. The motion of a wave of sound through them was compared to that of a wave of water at the bottom of the ocean, seeing that we live at the bottom of the ocean of air. The existence of nodal points in a tube was explained by the fact that there are two sets of waves present, traveling in opposite directions. The first waves are reflected on reaching the bottom of the tube, and return, meeting the following waves. At certain points these waves unite, producing a greater wave, while at others they neutralize each other, one tending to pull a particle down while the other tends to lift it up at the same time, and so the particle remains at rest. It is not quite correct, however, to suppose that the particles move up and down. They really move in small circles, as has been shown by the brothers Weber of Germany, who suspended fine particles in troughs of water and studied their motions.

There must be something to convey the sound to the ear. In our experiments we have assumed that the air conveyed the sound, and it generally does. If we put a bell rung by clockwork under a receiver and exhaust the air, the sound ceases altogether; on readmitting the air, it is again plainly heard. The transmission of sound is not, however, confined to the atmosphere. This was demonstrated by a very neat experiment. A music box was wound up and put inside a thick wooden box. Then the latter was closed tightly, and covered with numerous layers of woolen cloths until the sound was completely smothered. On placing an æolian harp in communication with the music box by means of a wooden rod about six feet long, the vibrations passed along this rod and the music became distinctly audible, being reproduced by the æolian harp.

There are several ways of finding the number of vibrations made by a body in a given time. One is to take a Geissler tube, through which sparks are sent from an induction coil as often as the circuit is completed by a vibrating body. On revolving the tube, each spark will illuminate it in a different position. By counting the number of flashes and knowing the rate of revolution of the tube, we can readily find the number of vibrations of the body breaking circuit Another way is to attach a fine point to the end of a tuning fork, whose rate of vibration is required, and draw it across a plate of smoked glass, while the fork is sounding. The point will scrape off the black and produce a sinuous line. The number of waves in this line, together with the rate of motion of the fork, will give us the rate of vibration. A third way of accomplishing the same thing is by means of the siren, an instrument consisting of a cylindrical brass box, having an aperture below for the admission of air and a number of small holes arranged in a circle in the top. Above this revolves a disk containing the same number of holes inclined in the opposite direction. The instrument is provided with an apparatus for registering the number of revolutions. When the air is forced in below, by means of an acoustic bellows, it escapes through the holes in the top and sets the disk in rotation. Each time two holes coincide the air escapes in puffs, and the result is a succession of sounds forming a note more and more acute the more rapidly the disk revolves. As we know the number of holes and have only to read off the number of revolutions on the index, the rate of vibration is easily computed.

The last topic considered was resonance. If we place two forks tuned to perfect unison, each mounted on a resonance box, several feet apart, and set the one in vibration, the other will soon take up the sound and continue it even after the first has been stopped. The particles of air struck by the first impinge upon the second with rhythmical and accumulating force until it too begins to swing.

Many other interesting points connected with this subject will have to be reserved until the next lecture, "On Harmony and Discord, with Optical Studies." C. F. K.

TO revive the color of black cloth garments, use a mixture of 2 pints vinegar, 1 oz. iron filings, 1 oz. copperas, 1 oz. ground logwood, and 3 ozs. bruised galls.