THE CHEMICAL DISCOVERIES BY THE SPECTROSCOPE.

Professor G. F. Barker, of Yale College, recently opened the fifth annual course of lectures before the American Institute in this city, by an able discourse on the above interesting subject. He explained the spectroscope and its uses, illustrating his remarks by pictures of the instrument thrown upon the screen, and described how different substances may be recognized by the autographs written in bands of color on the spectrum. Various experiments were performed showing the spectra of different metals by the aid of the electric light, and a lucid description was given of the method by which new elements have been discovered. The more important portion of the lecture related to the application of the spectroscope to the determination of subjects of general interest. After giving a brief explanation of the

BESSEMER STEEL PROCESS,

the lecturer stated that a flame issues from the mouth of the converter which is exceedingly characteristic, and, by applying the spectroscope to which, we may learn something by which a method may be obtained to stop the decarbonizing blast of air at the proper instant. Dr. Roscoe appreciated this, and accordingly made investigations at the Bessemer steel works of Brown and Brothers at Sheffield. It was found that when the blow begins, the flame is scarcely luminous, a mere glare of red, giving a very faint spectrum, if any. In about four minutes from the time the blast is let on, a flashing through the spectrum of the sodium line may be noticed. In about a minute and a half after this change, we discover lithium and then potassium. As the process continues, the flame becomes intensely luminous, owing to the silicon becoming incandescent. Then it gradually changes, and becomes slightly purplish, and, in a few seconds, passes to nearly the same color as at first. The first spectrum is an exceedingly simple one, but the last is complex, containing as many as 33 lines. The lines disappear in the inverse order of their appearance, and when the last green band becomes invisible, the blast should be shut off and the metal cooled.

ABSORPTION SPECTRA.

It is a singular fact that, if we take various colored substances, such as a set of dyestuffs, no two of them exert the same action upon light. The absorption spectrum is as distinct as the autograph of a metal. We may therefore distinguish one dyestuff from another, and thus we have an infallible means for the

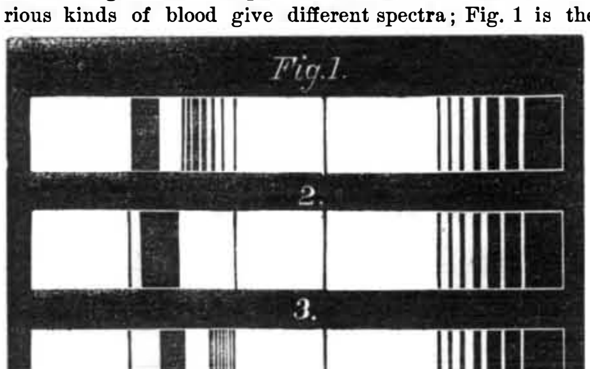
DETECTION OF ADULTERATIONS.

Mr. Sorby got a coloring matter from grape juice, which he called "Vitis purple." If this be suitably treated with citric acid, we have a solution the color of which cannot be distinguished from that of fresh port. If more acid be added a further oxidation is noticeable, and then it resembles the spectrum of port about ten years old. By adding more the spectrum becomes like that of port which is still older, there being a certain coloring matter which changes in its character by oxidation. In regard to adulteration of wines, Mr. Sorby believes that, as a general rule, such is not the case with colored wines. The lecturer stated that, in his own investigations, he had clearly seen the spectrum of logwood in a sample of port, and that he considered the popular belief, as to the use of Brazil wood and the common Virginian poke, to be not without reason.

Mustard, it is found, is almost uniformly adulterated with turmeric. Inferior rhubarb is also caused to imitate superior qualities. There is a kind of cheese bought in the English markets which has a curious yellow color which has been proved to be due to annatto. Professor Barker added that he once tested a suspiciously yellow sample of butter, and that the spectrum obtained was plainly that of carrots, but whether the coloring matter was introduced by the manufacturer or the cow, he was unable to determine.

COLORING MATTER OF HUMAN BLOOD.

Professor Stokes was the first to apply the spectroscope in the investigation of the spectrum of human blood. The various kinds of blood give different spectra; Fig. 1 is the



spectrum of arterial blood, Fig. 2, that of venous blood, and Fig. 3, of the dried coloring matter in blood. To show the utility of the spectroscope as a means of determining the presence of blood, Professor Barker mentioned the following instance

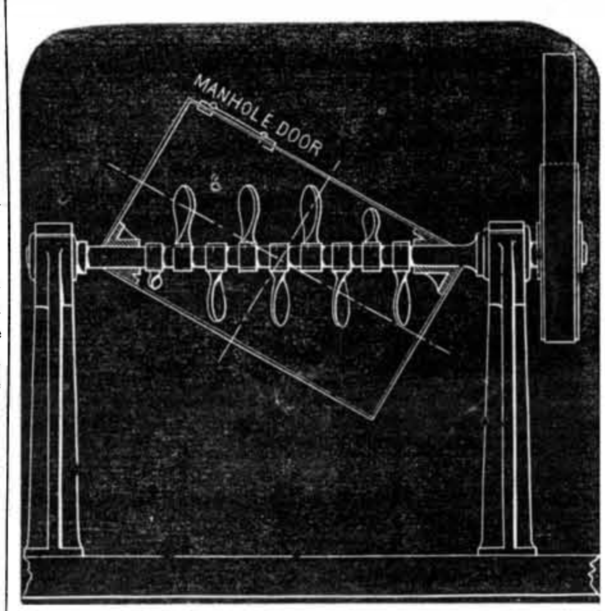
A case of suspected murder by means of some dull instrument was once given to Dr. Herapath to investigate. At some distance from the place where the crime was supposed to have been committed, a hatchet was found several weeks after, lying in the woods. It was stained with a drop of some dark substance. The Doctor, obtaining the implement, drove out the handle, and, slicing off a small portion of the stained wood and adding water to the shavings, obtained a few drops of a brown dirty solution, which coagulated by heat. He then cut off another very small portion of the wood and obtained a single drop of dirty liquid, which he placed in a tube, and light through this, being examined with a prism, gave the characteristic absorption spectrum of pematine—the coloring matter of the blood. He estimated the whole quantity of matter examined as weighing 1½ grains. Yet this was sufficient to enable him to detect the substance and bring the guilt home to its perpetrator. Now blood varies in character with the different gases which may have been added to it. This happens in many cases; for instance, when people are suffocated by going down into vats or wells. In these cases the blood contains a certain amount of carbonic acid. The spectrum given by blood in this state is perfectly distinct from that given by blood in its normal condition. In like manner, when blood is compounded with sulphuretted hydrogen, prussic acid or other foreign substances, the spectrum is in each case distinct and peculiar. Knowing these facts, the cause of death may be determined in many cases where it is impossible to detect it by any other means

Blood corpuscles are so extremely small that 3,200 of them only measure one inch, yet the presence of even a portion of one may be tested by the spectroscope. Dr. Herapath says that it is perfectly easy to detect and ocularly examine the human blood in the stomach of a flea. We may even dilute this blood with a teaspoonful of water without its losing its property, if the insect has been dining off a sanguineous individual.

Professor Barker concluded with a review of the field passed over, and an eloquent tribute to Professor Tyndall for his efforts in behalf of original investigation.

MIXING CYLINDER FOR CONCRETE.

We are indebted to Mr. G. C. Reitheimer, the superintendent of the Government submarine works at Hell Gate, N. Y., for the accompanying excellent design, of his own invention, for a concrete mixing cylinder. The apparatus



was used with every success, by Mr. Reitheimer, in the construction of the great breakwater at Holyhead, England. The revolving cylinder, of boiler iron, is immovably attached, as shown, to the axle which passes diagonally through it. Also, firmly fastened to the axle, are a number of knives or cutting blades arranged in spiral form. Motion is communicated by means of the belt wheel on the right of the engraving. The components of the concrete are introduced into the apparatus through the hinged manhole door. The machine is then set in motion, making some twenty-five revolutions per minute, causing the material to fall alternately from end to end of the cylinder, meeting in its progress the sharp edges of the knives. At the above speed, no effects of centrifugal force which would tend to keep the material in a single position are encountered. After the concrete is thoroughly incorporated, the cylinder is rotated so that the door is at the lowest point, when it is only necessary to open the manhole to allow the mixture to fall into a receptacle placed underneath.

Underground Telegraph Wires.

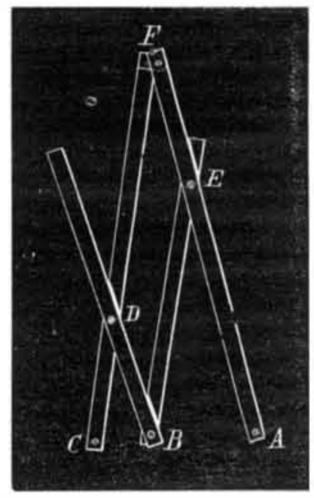
A recent heavy rain followed by a severe frost in this city played great havoc with the telegraph wires. The weight of ice was so great as to cause innumerable breaks, so that the elaborate fire alarm system became useless, and for a time it appeared as if communication with other cities was to be seriously interrupted. This has caused a re-agitation of the subject of underground wires, which, it is justly believed, would prove of great advantage as compared with those now in use. Not only would the unsightly telegraph poles be removed from our streets, but such casualties as the above, due to the weather, would be permanently averted.

Professor Silliman, in a recent letter, points out some of the difficulties incident to the underground plan. He says that gutta percha covering will not answer for insulation where it is exposed to the action of moist earth and vegetable processes. An element also, that is to be carefully considered in carrying out a general system for underground telegraphs in cities, is the facility that must be given for relaying in case of accident or of excavations in the streets for constructive purposes. If, however, says the Professor, the wire is once properly laid underground in insulatory material proof against natural agencies of destruction, the "electrical leakage" is very small, so much smaller than is possible with wires in the air as to be a great saving to the tele graph company.

THE PANTAGRAPH.

The pantagraph is an instrument for copying drawings, producing the copy on an accurately enlarged or reduced scale. It is much used by engravers and designers, and, to some extent, by mechanical draftsmen. It was invented in 1803, by Christopher Scheiner,* a Jesuit, and has been improved and modified by Professor Wallace, of Edinburgh, who rechristened it "eidograph," and by M. Gavard and others. As now made, it is a very neat and quite useful instrument.

The principle involved is that of the proportional compass, and, although, for nice work, it should be made of metal and with great accuracy, any good mechanic can construct it in hard wood, and with sufficient exactness for ordinary purposes.



The four rulers, jointed together by pins at their intersections, as shown in the figure, are supported on light, smoothly running casters, and carry a pen or pencil at A, and a tracer at B, or *vice versâ*, and the point, C, is held fast to the paper by a weight on which it is pivoted, and around which the whole instrument swings. A, B, and C are all interchangeable. The arms are graduated to indicate where the movable points of junction, D and E, must be arranged for any desired degree of reduction or enlargement of the scale. If the reduction is to be to one half its linear, or to one quarter its superficial dimensions, place the original drawing under the tracing point at A, the pencil at B, and let C remain unmoved. The joints, D and E, must each be made at the middle of the length of the long arms A F and C F, making the distances B B and B E equal to the half length of A F. The tracing point at A being now moved over the lines of the drawing, the pencil at B will describe precisely similar lines, and will make an exact copy, of half size. For the system is a kind of parallel motion, which compels the tracing point to remain, at all times, in the vertex of the angle, D B E, of a parallelogram whose sides are B D, D F, F E, and E B, no matter to what extent the angles may be altered. Then, if the three points move in the direction of the line containing them all, B will move but one half as far as A; and, if the instrument swings about C, B will again move but one half as far as A; and any combination of the two movements, by which any other line may be described, will give B a motion having the same relation to that of A. The point, C, always remains at rest. By putting the pencil at A and the tracing point at B, it is evident that the drawing will be copied on a double scale.

Placing the rods so that their junctions, D and E, shall occur at one fourth the lengths of C F and A F from C and from F respectively, and constructing thus a new parallelogram, D B E F, the original drawing may be reduced or enlarged four times. And, generally, the two triangles C D B and B E A, being similar in consequence of the parallelism of their sides, the distance BC : BA :: DC: EA and CC: CF:: E F: EA. So long as this proportionality is preserved, the instrument will be accurate, and the scales of the two drawings will be to each other as the distances of the pencil and of the tracing point, from the fulcrum or pivot of the pantagraph.

In our sketch, we have represented the simplest form of this instrument, and such as will be found easy to make and yet very convenient and useful. It can be purchased of the dealers in drawing instruments in a variety of improved forms and at correspondingly high prices. We have no doubt that many an apprentice, who reads our paper, will find this little "bundle of sticks" a most useful addition to his collection of drawing instruments.

Gas Burners.

In batswing burners it is found that, though the size of the flame diminishes with the amount of gas consumed, it is not in equal ratio. The cost of a large flame for each candle power per hour may be, for instance, 0·42 centimes, while, with a small one, it will be 0·897 centimes. Or, again, the light of a large flame may be equivalent to 15 candles, while that of two small ones together will be 7·4 candles. The cause of this is attributed to the complete combustion of the gas in the blue zone of the gas flame, which gives little or no light in either case, and has more favorable circumstances for its occurrence relatively to the size of the flame in the small than in the large flame. Another more inexplicable phenomenon is that with a flat flame the intensity of the light is the same, whether the edge or the flat of the flame is tested. This points to the absolute transparency of the flame. The use of cylindrical glass chimneys with round jets (argand, etc.) is concluded to be, on the whole, somewhat more economical than with flattened chimneys, after a series of experiments to settle this point.—*M. Offret.*

MANUFACTURE OF CHLORATE OF POTASH.—To manufacture chlorate of potash on a large scale, it has been recommended by W. Hunt to adopt the following method: Milk of lime is made to trickle down over bricks placed in a tower where it comes in contact with a continuous current of chlorine gas. Chlorate of lime is the chief product, and, by treating this with chloride of potassium, chlorate of potash is formed, which can be purified by crystallization.

**Pantagraphica, sive Ars Delineandi*, etc., Rome, 1623.