of transformer which has been employed at the Thomson-Houston works. The core, L, is formed of a bundle of fine iron wires, and around it is wound the primary coil, P, the terminals of which, AA, are connected to an alternating current generator, giving 50 to 100 alternations per second. The length of the wire core is 12 in. and its diameter $\frac{1}{4}$ in. The secondary coil, S S, is composed of 64 No. 10 (Brown and Sharpe's gauge) copper wires, wound in parallel eight times around the primary. The ends of this coil are bolted to copper plates on which are mounted clamps, C C, for the reception of the two rods, R R, which are to be welded. One of these clamps is movable, and is constantly pressed toward the other by a spring, so that the pieces to be united are kept in firm contact. The resistance of the secondary coil is 0.00015 ohm, and the amount of energy given off by it can be varied by moving the core, L L, in and out of the primary coil.

Fig. 2 illustrates another construction of transformer. The primary coil, P, is a ring 12 in. in diameter, $\frac{1}{2}$ in. wide, and $\frac{1}{4}$ in. thick, of many turns of insulated copper wire. Its ends, A A, are connected to the terminals of the alternating dynamo. The secondary coil is a single heavy bar of copper, bent to make one turn outside the primary coil, and is represented by the heavy black ring, the terminals of which, S S, are bent out parallel, and connected to massive clamps, M M. The arms, T T, can be forced apart by the screw, C, and drawn together by the adjustable spring, D. The primary and secondary coils are wound with an endless coil of iron wire, II. This does not touch the coils, but is laid on a sheet iron casing, the secondary coil being free. The resistance of the secondary coil is 0.00003 ohm, and under the influence of a good primary current it gives an electromotive force of 2 volts; less, however, is used in most cases. In the primary circuit there is used a current of 20 amperes and 600 volts, generated in a dynamo weighing 500 lb., and absorbing 25 horse power at 1,800 revolutions.

During the lecture mild steel rods, $\frac{1}{2}$ in. in diameter, were placed end to end in the clamps of the machine (Fig. 2), and were welded before the audience. Copper

and brass rods were similarly treated, and tests were afterward made to demonstrate that the joints were perfectly sound.

SEPARATION OF NICKEL BY THE MAGNET.

By THOMAS T. P. BRUCE WARREN.

DURING the winter of 1881-82, while lecturing to a class at the Silvertown Institution, on Electricity and Magnetism, I was desirous of showing to the students the magnetic property of metallic nickel. Through the kindness of Matthew Gray, Esq., at that time President of the Institution, I borrowed from the India-rubber, Gutta-percha, and Telegraph Co., Silvertown, a specimen of nickel cubes, which consisted in fact of two samples received some time before from Germany. The difference in price of the two samples was so little that they were thrown together into a drawer, as it was thought at the time that there could not be much difference between them with respect to purity, etc.

A handful of these cubes was placed on the table, and, on bringing an ordinary compound horse-shoe magnet near the cubes, I was very much surprised to find that, while some of these cubes were forcibly attracted by the magnet, others were not affected at all, or so slightly that they could not be supported by the magnet against their own gravity. Some cubes were attracted slightly when placed very near to the magnet, but could not be lifted.

I thought the matter of sufficient interest that I intrusted the chemical examination of these samples to one of the students in the laboratory of the Institution.

I afterward examined the whole of the nickel contained in the drawer with the magnet in the same way, and in two or three minutes I had the samples sorted out into their original lots of two kilogrammes each.

The magnet readily picked out the better quality at the rate of twenty or thirty cubes at a time, until what was left could not be drawn out by the magnet. To make sure of the result, the "magnetically selected" cubes were again tested with the magnet, when it was found that a few non-magnetic cubes had been drawn up by entanglement with the others. By the second operation, the separation was perfect.

There was no very marked difference in these cubes which would lead one to suspect anything worth noting. A closer examination showed that the non-magnetic cubes were a trifle whiter, and presented the absence of a striated structure, which was well defined, though unequally, with the magnetic cubes.

This method of examination was extended to samples of English grain nickel, and also to portions of anodes of English, American, and German manufacture.

It may be sufficient to remark here that the grain

nickel was powerfully attracted, and that the anodes, although drawn up by the magnet, were not so strongly attracted as the grain or magnetic cubes.

The fact that nickel has become an article of commercial importance, and that chemical analysis has disclosed the fact that this metal is liable to extensive adulteration, which can be so easily detected by the magnet, led me to believe that this subject deserved a more extended examination.

Special examinations of these cubes were made for lead, bismuth, antimony, cobalt, and sulphur, which were decidedly absent, although traces of some of these were detected in the anodes.

The following gives the percentage of composition of the cubes referred to:

	Magnetic.	Non-magnetic.
Copper	0.083	33.779
Carbon	0.071	0.365
Silica	0.409	0.160
Iron	2.457	0.841
Arsenic	0.117	0.865
Tin	0.749	0.461
Nickel	96.670	63.690
	100.556	100.161

The oxide of nickel obtained from the non-magnetic sample was reduced by heating in a current of hydrogen. This reduced metal was then even more magnetic than the other sample. A portion was placed in a test tube, which was inserted between the poles of a powerful horse-shoe magnet. It readily took up an axial position, which was not disturbed on carefully rotating the tube.

Portions of this metal were alloyed with small quantities of tin, arsenic, and antimony separately, which had a decided effect on its magnetic property.

Cobalt in its pure state behaves like nickel, and when alloyed with paramagnetic metals is similarly affected.

I have extended the examination more recently to nickel crucibles and dishes, and also to the wire triangles before and after heating, all of which are magnetic both before and after heating.

I have frequently noticed that the loss on one of these crucibles, when strongly heated over a Bunsen burner, is very slight compared with the bulky accumulation of black deposit which is produced. A few days ago I collected considerably over a gramme of this powder, which on analysis consisted almost entirely of graphitoid carbon, with minute quantities of nickel, iron, and silica.

I may mention that a platinum crucible heated in the same flame remained quite bright. The curious deduction arising from this is that these vessels are capable of actually decomposing the gas in a Bunsen's flame. A precaution which should therefore be taken is not to use these supports for platinum crucibles.

This unlooked for result led me to use hydrogen as a means of heating these nickel crucibles, taking care, of course, that the intense heat was not allowed to act injuriously on them. If coal gas be used, the flame must not be allowed to impinge upon the crucible.

I have now some experiments in hand with a view of ascertaining their behavior in a muffle furnace, heated with ordinary gas, as alkaline fusions for the analysis of earthy minerals are frequently required in practice.

So far as my experiments have gone, the crucible gains in weight, due to oxidation when heated in a muffle, but there is this difference—that the oxide formed is strongly adherent to the crucible, and is not rubbed off by the fingers, in the hydrogen flame. Oxidation does not take place on heating, but the precaution is necessary, to allow the cooling to go on in a current of this gas in order to avoid oxidation.

I find that there is a difference in the composition of the nickel gauze and wire supports and the crucibles and dishes. Malleability, so far as my analyses go, is produced by the addition of iron and manganese.

The composition of the malleable alloy from which the dishes and crucibles are made will be given in my next paper on this subject.

I may just state that commercial manganese and some other metals which are generally classified as magnetic are met with, in which magnetic attraction is notoriously absent. This deserves attention, as in the construction of magnets other metals are added to iron to increase its retentive power when hardened, and it is by no means improbable that the polarity of soft iron may be modified as regards its residual magnetism by the addition of other metals of the same or opposite series.—*Chem. News.*

PHOSPHORESCENCE OF ALUMINA.

By EDMOND BECQUEREL.

IN a memoir recently presented by M. De Boisbaudran to the Academy (vol. ciii., p. 1107), it is asserted that very pure precipitated alumina, when excited by electric discharges in a vacuum, does not give a red light, which, however, can be made to appear by the addition of 1-10,000 oxide of chrome. The author of that memoir deduces from his observations that the characteristic red light is not derived from alumina, but is due to the presence of chrome. M. Becquerel, on repeating the experiment with some of the very same material, obtained an opposite result, in conformity with his former observations. Some fragments of this supposed pure alumina were fixed on a slip of mica with a little gum, placed in the phosphoroscope, and excited by means of the electric arc. They gave an emission of red light, but very feeble and less intense than the light emitted by alumina containing chromium oxide, and submitted to the same treatment. But if this pure alumina is ignited for fifteen minutes in a porcelain crucible placed in a gas furnace fed with compressed air, it becomes as brilliantly luminous and red in the phosphoroscope as alumina containing chrome. In the phosphoroscope we can see bodies only if their luminous emission, after irradiation, has a certain duration measured by the speed of rotation of the disks of the apparatus, but as active bodies may emit, simultaneously, luminous rays the durations of which are different and shorter than that measured by the rotation of the disks, we can perceive

these rays only at the moment when the light acts upon the bodies, that is to say, according to the case, either by means of the ultra violet light or, as the author has shown for the first time (see *Annales de Chimie et de Physique*, 3d series, vol. lv., p. 92) by the aid of electric discharges or effluves in a vacuum. In these latter conditions we have the luminous effects which have been named effects of fluorescence, and which differ from others merely by their duration. Hence the effects presented by bodies excited by these different means are not the same. Further, in case of the effluve the bodies may receive the influence of rays much more refrangible than those furnished by concentrated sunlight, or even by the electric arc, and perhaps these bodies may be also directly excited by the electric discharges themselves. The effluve in a vacuum excites bodies differently according to the degree of exhaustion, and one body may give no effect in an insufficient vacuum, while it is brilliant in one more perfect. Conversely, another body may be more luminous in the first case than the second, though both are strongly excited in the phosphoroscope. It may happen that the effluve, acting upon mixtures, excites differently each substance contained in the mixture. The effects observed in the phosphoroscope are more simple, but cannot be obtained with all bodies. Those observed in a vacuum by means of the effluve are much more complex, but on analyzing the light emitted with the spectroscopic we may deduce interesting conclusions as to the nature of the substances.

THE CAPILLARITY AND DENSITY OF LIQUIDS.

TAKE two glasses (claret glasses, for example), of exactly the same diameter at the rim, and immerse them in a pail of water. Before removing them from the liquid, place them rim to rim, so that both shall re-

EXPERIMENT ON THE CAPILLARITY AND DENSITY OF LIQUIDS.

main full of water, as shown in the figure. We shall thus have two glasses full of water and containing no air. It will now be easy, by acting with caution, to separate them slightly, so as to leave a small space between their edges. Now take a third glass containing wine, and pour the latter, drop by drop, on the foot of the upper glass and allow it to spread over the latter's surface. Upon reaching the line of separation, the wine, instead of continuing its descent, will be seen to enter in streamlets between the two glasses and rises slowly in the upper one, owing to the difference in density of the wine and water. It is possible in this way to color the water in the upper glass entirely red without tinging that in the lower one.

The wine keeps to the upper glass through the action of capillarity, and rises therein, as before stated, by reason of the difference in density of the two liquids.

This is an experiment that anybody can try, and one that may be utilized in a lecture course.

We must add that the two glasses should be placed on a tray, or something of the kind, in order that the excess of wine may be caught, since considerable trickles down the lower glass, while a fraction of it rises in the upper one.

SULPHUROUS ACID IN THE CHEMICAL INDUSTRIES.

THE process of extracting phosphate of lime from crude phosphates by means of sulphurous acid instead of sulphuric acid is known in chemistry by the publications of Gerland, of Pavese and Rotondi, and others, and especially described in Ger. pat. 2,364 of 1873 and 814 of 1879. The crude phosphates are treated with a strong solution of sulphurous acid in water. The solution thus obtained, containing bisulphite and monobasic phosphate of lime, is heated, bibasic phosphate of lime is precipitated, and sulphurous acid is disengaged, which passes back into the dissolving vessels. If the crude phosphates contain, however, large quantities of free lime, or carbonate of lime, all this lime is also dissolved by sulphurous acid as bisulphite of lime, and will also be precipitated, together with the phosphate of lime, by heating the solution obtained. This precipitate, therefore, would not contain more phosphoric acid than the crude phosphate. By the process of Haenisch and Schroeder, Ger. pat. 37,209, the free or carbonate of lime of the crude phosphates is reduced to sulphate of lime by treating the crude phosphates with sufficient quantities of sulphuric acid. When treating phosphates prepared thus,