

in circuit with a Bell telephone over one of the cells of his three-cell battery, a secondary intermittent or undulatory current was induced in the coil by that portion of the primary circuit transmitted through the cell, and a corresponding ticking was heard in the telephone.

In both these experiments, however, the effects observed must be attributed rather to the external current of the other cells than to the internal current of the cell under experiment; and the author is unaware that any successful attempt has hitherto been made to construct an instrument which shall utilize the whole of the internal current of a single voltaic cell for the production of electro-magnetic effects. While engaged in some experiments a few years ago, it occurred to the author that if a voltaic cell were divided into two portions, having the zinc element in one portion and the positive element in the other, and the solution contained in the one portion were connected to that in the other by a tube filled with the same liquid, the tube being coiled round a magnetic needle, a deflection of the latter, due to the current within the cell being forced by the convolutions of the tube to circulate around the needle, would be produced when the two elements were connected together, and an apparatus was constructed, which consisted of two glass tubes closed at their lower ends with perforated corks, through which the ends of the coiled tubes are inserted. Within the rectangular coil of the tube was suspended a magnetic needle, and the whole having been filled with diluted sulphuric acid, a plate of zinc was placed in one tube and a stick of carbon in the other. On making connection between them by means of a wire, a slight deflection took place, but owing to the feebleness of the current, the directive action of the earth's magnetism and the friction of the pivot, the instrument was not sensitive enough to be satisfactory, and the author therefore designed the instrument shown in the diagram, and which is exhibited on the table, which consists of two glass test tubes united together by a small tube about 2 ft. long, and convoluted into two circular coils after the manner of a Thomson's reflecting galvanometer. Within the coils is suspended an astatic system of magnetic needles of which the upper carries a light mirror by which its deflections may be made apparent by the movement of a spot of light on a screen. It may, therefore, in this respect be looked upon as a Thomson's reflecting galvanometer, coiled with liquid instead of with metallic wires. The elements are placed one in each of the little cells, and may be connected by a key; or, by placing a reflecting galvanometer in the external circuit, both currents may be simultaneously indicated on the screen and their interdependence or identity be demonstrated. The first instrument constructed by the author was made by connecting the two cells by means of a tube of India rubber coiled round two cardboard cylinders, but through the kindness and unrivaled skill of his friend Mr. Gillingham, whose name is now inseparably connected with the splendid researches of Mr. Crookes, he was able to produce the instrument on the table, in which the tubes and coils are of glass all in one piece, and it is a very beautiful specimen of accuracy of glass blowing. Below the base of the instrument is a fine slightly magnetized sewing needle, which can be rotated on a vertical axis through a small angle by means of a little lever, and by which the instrument can be adjusted to zero.

The author has been induced to bring the instrument before Section A of the British Association, in the hope that it may be useful, not only for science teaching, but for aiding investigations connected with the physical action of the voltaic battery.

#### GAIFFE'S NEW BATTERY.

THE report by M. le Comte du Moncel on M. Gaiffe's peroxide of manganese and zinc chloride battery states that the advantages of the Leclanché battery (manganic peroxide and sal ammoniac) are well known, as it will act for entire years without attention. Hence it is almost universally applied for electric purposes where no great power is needed. If the manganic peroxide, however, is once exhausted they are rendered unserviceable, and must be replaced by new ones. M. Gaiffe, by his new arrangements, has overcome this difficulty, so that the elements may be charged as easily as in other batteries. He places the peroxide of manganese in several deep holes excavated in the cylinder of carbon, which forms the negative electrode and which serves at the same time as a porous vessel. This carbon is steeped in a solution of zinc chloride, which serves as the exciting liquid, and a rod of amalgamated zinc forms the negative pole. The chloride of zinc should contain from fifteen to twenty of the salt of zinc, as neutral as possible and free from lead. The manganese should be in granules. The electromotive force of this element is equal to a couple and a half of Daniell.

#### THE CURRENTS OF AMPERE, AND ON RESIDUAL MAGNETISM.

By M. TREVE.

A SHOCK upon an electro-magnet, whether solid or tubular, at the moment when the current ceases, is sufficient to diminish the duration of its demagnetization to a considerable extent, and is consequently a remedy for remanent magnetism.

#### ON THE PRESENCE OF NITROGEN IN STEEL.\*

By ALFRED H. ALLEN, F.I.C., F.C.S.

THE author made some preliminary experiments on this subject in 1872, but has only recently obtained any definite results. The method adopted has been to dissolve the steel in hydrochloric acid, by which means any combined nitrogen may be presumed to be converted into ammonia. The solution obtained was then distilled, with excess of lime, and the distillate examined for ammonia by Nessler's method. The employment of this extremely delicate test enabled the author to operate on a much smaller quantity of steel than was employed by previous investigators. Very special precautions were taken to obtain the hydrochloric acid and other materials free from any trace of ammonia or nitrous compounds, and the air was entirely expelled from the apparatus before commencing the operation. The hydrogen evolved was free from any traces of ammonia, by passing it through a tube filled with glass beads, moistened with hydrochloric acid. It was proved by blank experiments that no source of ammonia existed in the reagents or apparatus.

When absolutely pure materials were used, and every precaution taken to get rid of the contained air and other sources of error, the addition of Nessler's solution to the liquid obtained on distilling with lime, caused a very marked

yellowish brown coloration. On comparing the tint produced with that yielded by a dilute solution of ammonium chloride of known strength, results were arrived at representing the proportions of nitrogen present in various typical specimens of steel.

As the results obtained from steels of different kinds varied greatly, it cannot be assumed that there was a constant source of error in the mode of manipulation; while, as the same samples gave substantially concordant results on repeating the experiment, the figures obtained are not the result of accident, but are true expressions of the proportions of nitrogen present.

In order to obtain ammonia in quantity sufficient for its recognition by other reactions than that with Nessler's test, the following plan was employed:

Steam, generated by boiling water in a flask, was passed over a considerable quantity of steel borings, contained in a combustion tube, which was bent beyond the furnace, and prolonged so as to form the inner tube of a Liebig's condenser. To the further end, a tube filled with glass beads and furnished with a glass stop-cock was attached. A rapid current of steam was driven through the apparatus for a considerable time, to expel every trace of air. On condensing the steam, it was found free from any trace of ammonia. The steel borings were then heated to redness by a combustion furnace, and a rapid current of water passed through the condenser. The condensed steam, when tested by Nessler's solution, was found to contain abundance of ammonia, which did not diminish in amount till the borings were almost entirely oxidized. On re-distilling the condensed steam, a distillate was obtained, having a distinctly alkaline reaction to litmus paper, and on treating it with hydrochloric acid and platinum chloride, a sensible amount of yellow precipitate was obtained, having the characteristic crystalline form of ammonium chloroplatinate. The amount found was larger than could possibly have been produced had the whole of the nitrogen of any residual trace of air been converted into ammonia.

The author regards the results now recorded as preliminary merely, and proposes to extend the research to various classes of steel and iron, and especially to such specimens as have been found to possess anomalous characters. Of these characters, the evolution of ammonia from freshly fractured surfaces is among the most striking.

#### THE FINEST DIAMONDS IN THE WORLD.

WESTERN sovereigns are not the possessors of the finest diamonds in the world, for the Rajahs of Matan, Borneo, and the Shah of Persia have the largest hitherto known. The one belonging to the Emperor of the Mongols weighed 279 carats (about four grains each), and was valued at 12,000,000 francs. The famous Orloff, the property of the Russian crown, is one of the most remarkable diamonds, on account of the well known circumstances under which it was brought to Europe. The large stone belonging to the Emperor of Brazil, which weighs 1,730 carats, would be worth many millions were not its brilliancy diminished by certain defects. The Sultan of Nizam's diamond weighs 400 carats; that of the Emperor of Austria 29 grains; and that of the King of Portugal, 25½ grains. The famous Koh-i-Noor, or Mountain of Light, is the property of the Queen of England. The one which adorned the tiara of Pius IX., and was bequeathed by him to his successor, Leo XIII., is one of the finest stones known. It came from the treasury of the Duke of Burgundy, seized at Granson. It was sold after the battle to a Jew of Berne for 3 crowns, then successively for 5,000 and 6,000 ducats, and afterward purchased for 14,000 by Luigi Sforza, from whom it passed into the hands of Pope Julius II. for 20,000 ducats. Every one knows that the "Regent," of the weight of 136 carats, is the finest of the diamonds belonging to the French regalia. Connoisseurs consider it to be worth 12,000,000 francs.—*Galignani*.

#### ON THE DISSOCIATION OF CHLORINE.

By F. P. DUNNINGTON, University of Virginia.

IN view of the following facts, the question suggests itself whether due care has been taken to exclude the possibility of oxygen compounds being present in the experiments, from which the decomposition of chlorine was inferred, in the article published in the *Chemical News*, vol. xl, p. 69.

During the past year, in undertaking to making liquid Cl from PtCl<sub>4</sub> made by HNO<sub>3</sub> and HCl (the latter in excess), I experienced some difficulty in obtaining it free of nitro compounds.

After heating about 30 grammes PtCl<sub>4</sub> until Cl was given off, thrice it was treated with water, causing the evolution of nitrous fumes, and heated again until Cl was given off. This material, sealed in a glass tube, on being further heated gave Cl, which condensed at first to a clear yellow liquid (exactly similar in color to that of liquid Cl made from Cl<sub>2</sub>H<sub>2</sub>O), but on continuing the heat the condensed liquid assumed a red-brown tint. From the fact of the nitrous fumes having been evolved when it was last treated with water, I presume the reddish tint of this liquid due to NOCl or NOCl<sub>2</sub>. On opening the tube, when most of the Cl had escaped, there remained an odor very similar to that of ClO<sub>2</sub>.

In a previous experiment, when the PtCl<sub>4</sub> was but once moistened after drying, the condensed liquid Cl had from the first this same tint, though to a more marked degree. In another experiment I did obtain the Cl from PtCl<sub>4</sub> wholly of the clear yellow color.

In these experiments the residue after heating consisted of PtCl<sub>2</sub>, with but little Pt and PtCl<sub>4</sub>.—*Chemical News*.

#### DETECTION OF PHENOL.

DR. E. HOFFMANN pours into a small test glass 1 or 2 c.c. of pure concentrated sulphuric acid, pours carefully over it, so as to form a separate layer, the same volume of the dilute aqueous liquid suspected, and drops in a few granules of potassium nitrate. If only 1 milligramme of phenol be present each particle produces at once violet streaks.—*Chemiker Zeitung*.

#### DENSITY OF CHLORINE AT HIGH TEMPERATURES.

By A. LIEBEN.

THE author comments on the fact observed by V. and C. Meyer that at temperatures exceeding 600° the sp. gr. of chlorine is only 1.63 instead of 2.45 (air = 1). He seeks to explain this fact by the supposition that above 700° chlorine follows a law of expansion different from other gases, its

coefficient of expansion being possibly somewhat higher than those of oxygen, nitrogen, gaseous sulphur, etc. He suggests as another explanation that at high temperatures the molecules of chlorine, Cl<sub>2</sub>, are dissociated into isolated atoms.

#### SAPONINE FROM THE BARK OF QUILLAIA SAPONARIA.\*

By H. COLLIER, Teacher of Pharmacy at Guy's Hospital

ONE of the subjects on the list of the Pharmaceutical Conference for investigation is quillaia bark, its chemical composition, properties, and uses. This bark had been under my notice for some time before the issue of this list, but as my chief aim has been to determine more precisely the nature of the saponaceous principle which it contains, I have adopted the above title for my paper. I have been assisted in my endeavors by my friend, Mr. Scard, F.C.S., chemical assistant to Dr. Pavy, F.R.S., Guy's Hospital, to whose practical chemical knowledge I am indebted for the various analyses of saponine which I am able to lay before you. I have by no means exhausted the subject; in fact, what I have to say must not be regarded as a complete investigation of saponine. I have obtained some results which may be looked upon as so many steps of progress toward the goal, but nevertheless there remain many points which are still obscure.

A principle which makes a froth with water similar to that formed by ordinary soap, is very widely diffused throughout the vegetable kingdom. Although generally known as saponine, from its original source, *Saponaria officinalis*, it has other names according to the plant from which it is obtained. All these saponaceous principles may be one and the same substance, modified, perhaps, by the impurities belonging to its extraction. Saponine has been the object of numerous investigations, but most discordant results have been published respecting it by different experimenters. Thus Bussy, Henry, Plisson, and Overbeck state it to be a white non-crystalline friable powder; Rochleder and Schwartz that it is colorless, and Quevenne that it is yellowish white. Again, according to Henry and Plisson it is inodorous, whilst Quevenne asserts that it has a peculiar aromatic odor, and Sharling that the aqueous solution has a repulsive odor. There is also a great difference in the formulas assigned to saponine. According to Rochleder and Schwartz it is C<sub>24</sub>H<sub>40</sub>O<sub>11</sub>, Overbeck C<sub>24</sub>H<sub>40</sub>O<sub>11</sub>, and Boileau C<sub>24</sub>H<sub>40</sub>O<sub>11</sub>.

Before proceeding any further with the consideration of saponine, I think it will be well to say a few words respecting the source, character, and microscopic appearance of quillaia bark. The following description is from the "Treasury of Botany," part ii, 952: "Quillaia saponaria, quillaia or cullay of the Chilians, is a tree from 50 to 60 feet high, with smooth, shining, short stalked, oval leaves, and usually terminal white flowers. Its bark, called quillaia or soap bark, is rough or dark colored externally, but consisting of numerous regular whitish or yellowish layers, and contains a large quantity of carbonate of lime and other mineral matters. It is rich in saponine, a vegetable soap principle, and on this account it is commonly used as a substitute for washing clothes, two ounces of the bark being sufficient to wash a dress. It is also said to remove all spots or stains, and to impart a remarkable luster to wool, and it is used to wash the hair, for which purpose it is powdered between stones, then rubbed with the hands in water, making a foam like soap."

The cortex quillaia which I have examined consisted of heavy flat or slightly curved pieces, varying in size from 1 to 4 feet in length, 4 to 8 inches in breadth, and from ¼ to ½ an inch in thickness. The outer bark had been removed; there were, however, a few scattered pieces still remaining. Le Beuf, who described the color of the tincture he obtained as "d'une couleur orange foncée," no doubt employed the bark without removing the remaining outside portions. Now this is an important matter, as this outer bark contains a coloring principle which contaminates the saponine. In all my experiments I have operated upon a bark from which every portion of outside layer had been removed by planing and the use of the chisel. The tincture from this is of a pale yellow color. It is not difficult to reduce the bark to coarse powder, if it is thoroughly dry, but if exposed to the air it absorbs moisture, and although it may easily be separated into layers, it is not friable. It is rather an unpleasant substance to powder, the fine dust which arises causing a great amount of coughing and sneezing. Examined by the microscope an opaque longitudinal section of the bark, with one inch object glass and oblique light, gives a general view of the woody tissue, upon and among which lie large crystals of what are undoubtedly oxalate of calcium, as they are unaffected by acetic acid, but are dissolved without any effervescence by hydrochloric. A longitudinal transparent section, part of which is stained with aniline, shows principally the woody fiber with crystals lying about. In the colored section some cellular tissue may be observed, and a few resinoid looking bodies of a brown color. I have one section here which is made in a part where the resinoid bodies are chiefly deposited. These are somewhat of an oval form, and I have every reason to believe they consist of saponine with impurities, giving them a brown color. The bark ignites very readily, and during combustion gives off an aromatic odor somewhat resembling cedar wood. It yields 11.8 per cent. of ash, which consists chiefly of calcium carbonate; there is also a trace of iron.

Henry and Boutron-Charland were, I believe, the first who investigated quillaia bark and separated its saponaceous matter, which they described as an acrid principle. The method they adopted was to boil the aqueous extract with water, filter at the boiling heat, and the saponine which fell down on cooling and concentration was purified by solution in alcohol with aid of animal charcoal. I have prepared saponine by this method, but I was unable to obtain it pure; it would persistently remain brown after all treatment.

The best process is that of Le Beuf, which consists in boiling the bark with 84 per cent. alcohol, filtering at the boiling point, and upon cooling the saponine deposits. It is purified by washing with alcohol and ether. The principle of the above process is that saponine is more soluble in boiling rectified spirit than in cold, so that the excess deposits upon cooling, leaving above a saturated solution of saponine with coloring and other matters. This tincture upon evaporation yields 2.24 per cent. of solid residue.

The first saponine I obtained by this process, after thorough washing with alcohol and ether, and drying over a water-bath, was a white friable amorphous mass. There were some portions, however, which were not white, but of a decided brown color, and there appeared an oily stain upon

\* British Pharmaceutical Conference.—*Pharmaceutical Journal*.

\* Abstract of a paper read before the British Association for the Advancement of Science, (Section B), Sheffield, 1879.