produced in all the apparatus employed by Dr. Bjerknes, by variations of pneumatic pressure, and in Fig. 4 (the following engraving) we illustrate the air-pump by which the alternate exhaustions and compressions are produced. This apparatus consists of two small brass cylinders fixed horizontally upon a wooden baseboard, each of which is fitted with a piston, to which a reciprocating motion is communicated by means of a small crank-pin and connecting-rod attached to a horizontal shaft, that can be rotated at a high velocity by means of a large grooved pulley to which a winch handle is attached. The throw of the crank-pins, and therefore the strokes of their respective pumps, can be varied from nothing to their fullest extent, and by making the pneumatic connection to one or other end of each cylinder, the two pumps may be arranged so as both to be compressing and both exhausting at the same time, or the one may be arranged to compress while the other is exhausting. In

If this apparatus be placed in the water and connected to one of the pumps, and the pulsating drum (Fig. 6) be connected to the other pump, it will be found, on presenting the latter to the movable drum after the manner illustrated in the diagram, Fig. 3, and rotating the pump-wheel, that when both pulsating drums are expanding and contracting simultaneously, the movable drum, A, will be attracted toward B, which effect is illustrated by the diagram, Fig. 8, the arrows showing the direction in which each is urged by the vibrating influence of the other. If, however, the one drum is expanding at the moment that the other is contracting—that is to say, if one be convex when the other is concave, repulsion will take place, and the movable drum will be driven away by the other in a manner precisely similar to that in which one end of a compass needle is repelled if a magnet pole of the same sign is presented to it. By employing a double drum, such as is shown in Fig. 7 (see pre-

ter, of which the chemical composition is not well known, but which can be attracted by a magnet. Many attempts have been made to use magnets systematically, but they have hitherto been unsuccessful. Two French establishments have lately employed the following method with very satisfactory results: Each electro-magnet is composed of two coils placed in a line; their remote ends are connected by a long piece of iron; the two near ends are but a short distance apart, one representing the north pole and the other the south pole of the electro-magnet; between them there is a magnetic field which can be made very powerful, provided there is a sufficient exciting current. A tight box incloses this magnetic field; it is open above, and has a round opening below into which an escaping tube is inserted. The porcelain paste, very liquid, running into the box, encounters a small zinc diaphragm which sends it to the right and to the left over the polar faces; the magnetic

FIG. 4.—BJERKNES'S HYDRODYNAMIC EXPERIMENTS.

all cases each pump alternately exhausts and compresses as the handwheel is rotated.

In the experiments at Paris, water was the medium in which the phenomena were exhibited, and Fig. 5 is an illustration of the tank employed with one of the most typical of the apparatus immersed in the water. This beautiful piece of apparatus is more clearly shown with its attachment to the pump in the front of Fig. 4. It consists of a pulsating drum attached to the end of a horizontal tubular arm which is capable of rotating, like a weathercock, on a hollow vertical axis by which the whole system, and therefore the interior of the pulsating drum, can be connected by a flexible tube with the reciprocating pump. The vertical axis of this instrument is centered between needle-points, and by means of an exceedingly ingenious device at the top of this axis the varying pneumatic pressure is communicated to the drum without stuffing-boxes and without adding to its frictional resistance to motion, the whole of the movable system turning as easily as a compass on its center.

ceding page), the analogy of the effect of a bar magnet upon a compass needle is still more strikingly illustrated. This drum is divided by a central rigid diaphragm into two chambers, each communicating with a separate hollow stem by which it can be connected to one or other of the pump nozzles; by connecting this pair of stems to the two ends respectively of the same pump, and the rotating drum apparatus to one end of the other pump, attraction and repulsion can be illustrated by presenting one or the other of the faces of the double drum toward the rotating instrument, thus illustrating the effect of the two poles respectively on one end of a compass needle.

PURIFICATION OF PORCELAIN.

THERE is a difference in commercial value of forty per cent. between pieces of porcelain which are absolutely white and those which present the slightest spot. The spots are produced by small quantities of ferruginous mat-

particles are retained and the rest escapes. The polar surfaces are cleansed twice a day by a jet of water. The apparatus may be worked either with a Gramme machine or with a battery.—*L'Electricien*.

THE PROCESSES OF MM. A. CLASSEN AND A. VON REISS FOR THE DETERMINATIONS AND SEPARATIONS OF METALS BY THE ELECTROLYTIC METHOD.

Report by V. FRANCKEN.

SINCE the discovery of the process for the electrolytic determination of copper, various chemists have sought to utilize this simple and elegant method for the determination of other metals. While in the attempts made hitherto the separation of copper succeeds best in a nitric solution, an ammoniacal solution is employed for the precipitation of nickel and cobalt, and a solution in potassium cyanide for zinc and cadmium. The exactitude of the results depends on strict observance of the conditions, which we shall explain.

For instance, the precipitation of copper gives quantitative results only, if the proportion of nitric acid in the solution is exactly that which has been established; the precipitation of cobalt and nickel is successful only if a determinate quantity of ammonia and ammonium sulphate has been employed. The electrolytic solution of the chlorides has not been hitherto directly practicable, so that it was first necessary to transform them into sulphates. Except the well-known separation of copper from the metals which are not precipitable in a nitric solution, and from those which are conveyed to the opposite electrode in the state of peroxides, the electric current has not yet been applied as a means of elimination in quantitative analyses. As will be seen below, copper, zinc, nickel, cobalt, iron, manganese, bismuth, tin, cadmium, whether existing as sulphates, chlorides, or nitrates, may be precipitated much more quickly and simply than they have been hitherto, and some of these metals may also be separated in one and the same solution.

DETERMINATION OF COBALT.

If we add to the solution of a salt of cobalt an excess of neutral potassium oxalate, and if the clear solution of oxalate is submitted to electrolysis, the intense red color soon passes to a deep green, which becomes gradually feebler as the cobalt is deposited in the metallic state at the negative electrode. The potassium oxalate is converted into carbonate by the current, and by degrees there is deposited along with the metallic cobalt a precipitate of cobalt carbonate. This precipitate is dissolved by adding cautiously oxalic or dilute sulphuric acid, and the whole of the cobalt is separated by the continued action of the current until the liquid again becomes alkaline.

The electrolytic separation of the cobalt proceeds much

FIG. 5.—BJERKNES'S HYDRODYNAMIC EXPERIMENTS.

more rapidly if the potassium oxalate is replaced by ammonium oxalate, which forms with the compounds of cobalt a double salt readily soluble, and if care is taken to add merely as much ammonium oxalate as is necessary to form the double salt of cobalt. There is deposited along with metallic cobalt a red insoluble cobalt oxalate, which is only slowly reduced by the current. To prevent this separation, the liquid, to which has been added ammonium oxalate in excess, is heated, and 3 to 4 grms. of solid ammonium oxalate are further dissolved. The boiling solution, when exposed to the influence of the currents, deposits the cobalt in the form of a gray adhesive coating. By this process, with two Bunsen elements, about 0.2 gm. of cobalt may be separated in the course of an hour. When the reduction is complete (which may be ascertained most simply by adding ammonium hydrosulphate to a small sample of the liquid taken out with a capillary tube), the positive electrode is withdrawn from the liquid which is decanted off, and the precipitate is washed several times with water, then with alcohol, and finally with absolute ether. The residue of cobalt is then dried in an air-bath at 100°, and in a few minutes gives a constant result.

DETERMINATION OF NICKEL.

We proceed precisely as in the determination of cobalt—i. e., we add to the solution ammonium oxalate in excess, heat, and add further about 4 grms. of the solid salt. The separation of nickel is effected as rapidly as that of cobalt; the nickel is deposited in a gray compact stratum, which remains firmly attached to the electrode.

DETERMINATION OF IRON.

The authors have used in these assays a solution of chloride and a solution of sulphate, and have proceeded exactly as above. The electrolysis goes on perfectly without separation of any compound of iron if there is present a sufficient quantity of ammonium oxalate. The iron separates out in a brilliant mass of a steel-gray color firmly attached to the platinum. The reduced iron may be exposed for days to the air without any perceptible oxidation.

DETERMINATION OF ZINC.

Zinc is separated from its solution as a double salt as easily and as rapidly as the preceding metals. The reduced zinc has a dark-gray color, and remains very firmly attached to the electrode. The separated metal cannot be dissolved by heating with dilute acids; in general it appears as a dark coating, which can be detached only by heating the capsule to redness, and treating the residue afresh with acid.

DETERMINATION OF MANGANESE.

It is known that manganese can be separated as peroxide from a solution to which nitric acid has been added. But, according to the author's experiments, the precipitation is complete only when the quantities employed are small, when but little nitric acid is used, and when the rinsing takes place without interruption of the current. If the manganese is converted into a soluble double compound by the introduction of an excess of potassium oxalate, and if the solution is then electrolyzed, all the manganese is precipitated at the positive electrode. If ammonium oxalate is employed, the precipitation is not quantitative. The peroxide separated is not firmly attached to the electrode. Hence it is separated by filtration and transformed into Mn_2O_3 by heating.

DETERMINATION OF BISMUTH.

This assay presents some difficulty. We do not succeed in separating the metal as a compact mass adhering to platinum, and the bismuth is always obtained in the same state whether it is precipitated from an acid solution, from the solution of a double salt of ammonium and of oxalic acid, or from a solution to which potassium tartrate has been added. If we give the platinum the greatest possible surface, and fill the capsule to the brim, we may, with a small quantity of bismuth, effect the rinsing in water, alcohol, and ether without loss. If in this operation particles of metal are detached from the capsule, they must be collected on a weighed filter and determined separately. In these assays we add to a nitric solution of bismuth a sufficient excess of ammonium oxalate. In the electrolytic decomposition we observe at the positive electrode a precipitation of peroxide, which slowly disappears. To preserve the reduced metal from oxidation it is necessary to remove the last traces of water by an abundant washing with alcohol and anhydrous ether.

DETERMINATION OF LEAD.

In a nitric solution lead behaves like manganese. When the quantity of peroxide separated is so considerable that it no longer remains firmly attached, and when it passes mechanically to the negative electrode, we cannot effect the determination without considerable loss resulting from the re-solution of the peroxide. The results are very uncertain.

If we submit the double oxalate to electrolysis, all the lead present is indeed deposited in the state of metal, but it is so quickly oxidized on exposure to the air that it is rarely possible to dry it without change, even in a current of coal-gas. The electrolytic determination of this metal cannot, therefore, be recommended.

DETERMINATION OF COPPER.

Copper is separated very rapidly and easily from the double salt which it forms with ammonium and oxalic acid, if only a sufficient quantity of ammonium oxalate is added. Weak currents cannot be used for the determination of considerable quantities of copper, as in this case the metal does not attach itself firmly enough to the electrode. The authors employ a strength of current corresponding to about a development of 330 c. c. of gas hourly, and can separate 0.15 gm. metallic copper in about twenty-five minutes.

DETERMINATION OF CADMIUM.

If the double oxalate of ammonium and cadmium is electrolyzed, we obtain the cadmium in the form of a gray coating, which, though not adhering very firmly to the electrode, undergoes no loss if washed with caution.

DETERMINATION OF TIN.

Tin can be very well determined electrolytically. It separates either from a hydrochloric solution or from the solution of a double ammonium oxalate in the state of a fine gray coating. If we use the potassium salt instead of ammonium oxalate, the electrolysis presents difficulties, for there appears at the opposite pole a basic salt which is not reduced. If the tin is separated from an acid solution the current must not be interrupted during rinsing—a precaution not necessary when employing the ammonium oxalate.

When the tin is detached from the platinum capsule it presents phenomena similar to those described under zinc. As a general rule, there remains a black residue on the electrode.

DETERMINATION OF ANTIMONY.

In a hydrochloric solution, antimony is precipitated in the metallic state, but not firmly attached. If to the solution of trichloride we add potassium oxalate the antimony is easily reduced, but the metal is still not attached firmly to the electrode. A firmly adhesive coating may be obtained by the addition of an alkaline tartrate, but the separation takes place too slowly.

The precipitation of antimony succeeds very well in a solution of its sulpho-salts. We add hydrogen sulphide to the solution, which may contain free hydrochloric acid; we neutralize with ammonia, and add ammonium hydrosulphate in excess. The reduction is accelerated by the addition of a little ammonium sulphate. The antimony is separated at the electrode as a fine light gray precipitate, firmly attached if the precipitation has not been hastened by the use of too strong a current. When the reduction is complete the liquid is decanted off, and the residue cleaned in the ordinary manner.

DETERMINATION OF ARSENIC.

Arsenic cannot be separated quantitatively either from an aqueous or a hydrochloric solution, or from one to which ammonium oxalate has been added.

In the aqueous solution, as well as in the oxalic, a part of the arsenic is reduced to the state of metal, while in the hydrochloric solution it is all volatilized as arsenamine if the action of the current is sufficiently prolonged.

SEPARATION OF IRON AND MANGANESE.

The separation of the two metals is only possible by preventing the formation of manganese peroxide until the greater part of the iron has been precipitated. We effect this object by the addition of sodium phosphate, or more easily by the addition of a large excess of ammonium oxalate.

In both cases there appears, under the influence of the current, the characteristic coloration of permanganic acid, which disappears afterward at the negative electrode. When the greatest part of the ammonium oxalate has been transformed by the current into ammonium carbonate, the color becomes permanent in consequence of the formation of manganese peroxide. We add, in the outset, ammonium oxalate to the liquid, apply heat, dissolve further 3 or 4 grms. ammonium oxalate in the liquid, and electrolyze at once. The separation of the two metals takes place immediately and exactly, especially if the quantity of manganese is small. It appears as peroxide at the positive electrode, while the iron is deposited at the negative. If the proportion of the manganese is more than double the quantity of the iron, the precipitation of the latter will last longer. It is then necessary, in order to effect a complete separation, to re-dissolve the deposit of peroxide in oxalic acid, adding the latter without interrupting the current, so long as the liquid has a red color.

In separating the two metals the authors find it useful not to apply too strong a current (2 Bunsen elements are sufficient), and not to re-enforce it unless compelled in consequence of too large a quantity of manganese, so as to re-dissolve the peroxide. When the assay is concluded, it is not prudent to let the current act, as then a little peroxide is deposited very firmly upon the iron, and must be dissolved off in oxalic acid, after decanting off the liquid, or the electrolysis must be repeated. As we have already remarked in treating of the determination of manganese as peroxide, the precipitation of this metal from a solution of ammonium oxalate is not quantitative. We must, therefore, boil the liquid which holds in suspension the greater part of the manganese in the state of peroxide, so as to decompose the ammonium carbonate. The rest of the ammonia is then neutralized with nitric acid, and the manganese is transformed into sulphide by the addition of ammonium hydrosulphate. The manganese sulphide is strongly heated in a current of hydrogen and weighed directly.

SEPARATION OF IRON AND ALUMINUM.

This separation, which offers serious difficulties by the ordinary methods, is easily effected by electrolysis. If we submit to electrolysis a solution (of ammoniacal oxide of iron and of aluminum ammoniaco-oxalate), to which a large excess of ammonium oxalate has been added, the iron is separated first as a coating firmly attached to the negative electrode, while the aluminum remains in solution as long as the quantity of ammonium oxalate is greater than that of the ammonium carbonate formed. If there is ultimately produced a precipitate of alumina, the solution is then almost entirely free from iron. A few drops of the liquid holding the aluminum in solution are tested from time to time with ammonium hydrosulphate, to find if iron remains and the current is interrupted as soon as no reaction is produced.

To make the determination we add ammonium oxalate in excess to a neutral or slightly acid solution. We may also, if needful, neutralize with ammonia. We add further ammonium oxalate in the proportion of 2 or 3 grms. per 0.1 gm. of oxide, and the hot solution is immediately electrolyzed. The current must not be allowed to act until all the aluminum is precipitated along with the iron. A part of the aluminum would then adhere to the iron so that it could not be detached. Then, as it has been said with reference to the separation of manganese, the iron must be redissolved in oxalic acid, the liquid containing the aluminum having been previously decanted and the electrolysis repeated.

In order to precipitate completely the alumina from the liquid which has been freed from iron, we add ammonia, heat for some time, and proceed in the ordinary manner. If the quantity of alumina is not greater than that of iron, this method gives immediately accurate results. In the contrary case the precipitate of aluminum is dissolved and electrolyzed again, adding oxalic acid cautiously, and not interrupting the current.—*Revue Universelle des Mines.*—*Chem. News.*

ANTISEPTIC COLOGNE.—The following is commended as a preparation combining antiseptic properties with a perfume:

Eau de Cologne.....	8 fl. oz.
Chloral hydrate.....	2 drachms
Quinine (alkaloid).....	10 grains.
Carbolic acid (pure).....	30 "
Oil of lavender.....	20 drops.

This may be used on the handkerchief, the doctor holding it gently to the mouth while in the sick room. Warranted to keep out bacillus tuberculosis; also b. termo, b. elephantiasis A., and b. gonococci.

ALCOHOL AND ITS EFFECTS.

By Rev. L. J. TEMPLIN.

THE earliest authentic account we have of the use of intoxicating liquors as beverages is in the case of Noah, who, it is said, planted a vineyard and became drunken on the wine made from the fruit thereof. From that time down we have frequent accounts of the use and effects of various kinds of intoxicating liquors among many nations and tribes of people. The most common source of these drinks in ancient times was the grape; but the palm tree, pomegranate, and melon have been extensively employed for this purpose in both ancient and modern times. In recent times the various cereals have come into very general use for this purpose. Various other substances, as fruits, milk, etc., are frequently employed for the manufacture of intoxicating drinks. It is only by a process of fermentation that the intoxicating principle is generated, as none of it is ever found in any living substance. In the process of decomposition of any organic substance containing sugar in the presence of water, it passes through three distinct stages; the alcoholic, the acetic, and the putrefactive. It is the business of the brewer and distiller to check the process when it has reached the first stage, and so manipulate their liquor as to prevent any further fermentation. Intoxicating drinks were in use many centuries before any correct knowledge of the true nature of the intoxicating principle was obtained.

The Arabian alchemists discovered that if wine was kept at the boiling point for a few minutes it lost its intoxicating power. The intoxicating principle, whatever that was, had escaped. But this powerful agent was invisible, hence it was regarded as a spirit—the spirit of wine.

About the middle of the eleventh century Avicenna caught this subtle agent, and gave it a visible, bodily form. Chemists called it "alcohol." This term comes from two Arabic words, Al, the, and Kahol, a fine, impalpable powder. The ladies of the East were accustomed to employ such powders at their toilet. The term "alcohol" seems to have been applied to any powerful, subtle agent, but its modern use is confined to the intoxicating principle or strong drinks—the spirit of wine. The process by which this agent is developed is now quite well understood. If starch be moistened with water in which a little ferment, as yeast, has been dissolved, and subjected to a temperature of one hundred degrees of heat, it will be changed to grape sugar. But if the temperature be maintained in the presence of a ferment it will be decomposed and its elements separated into carbonic anhydride and alcohol. The gas speedily escapes into the air and the alcohol remains dissolved into the water. By distillation this is separated from the principal part of the water, the remainder of which may be removed by certain chemical processes and absolute alcohol obtained. It was once believed that alcohol was the product of distillation, but it is now known that this process only separates the alcohol that has already been generated by fermentation. The alcohol in general use contains from seven to fifteen per cent. of water. Pure alcohol is a transparent fluid having a specific gravity of 796, water being 1,000. It has a very pungent taste, boils at 170°, and has never been frozen. It inflames at 800° burning with a pale blue flame, emitting no smoke, little light, but much heat. This agent is a powerful solvent, readily dissolving most of the resinous gums and vegetable extracts. Chemically, alcohol is composed of three gases in the following proportions:

Carbon.....	51.88
Hydrogen.....	13.70
Oxygen.....	34.42

100

The amount of alcohol that is found in the different kinds of intoxicating drinks varies with the different classes and kinds of liquors. The following exhibits the proportion of alcohol and proof spirits found in the different kinds of fermented liquors:

	Alcohol.	Proof Spirits.
	per cent.	46 per cent.
Port wine.....	23	46
Madeira.....	22	44
Sherry.....	19	38
Champagne.....	12½	25
Cider.....	7	14
Porter.....	4½	8½
Ale.....	6½	13
Small beer.....	1½	2½

From this it will be seen that these drinks contain from one fortieth to nearly one half of proof spirits. The proportion of alcohol found in the various kinds of distilled liquors is—

Brandy.....	53.39 per cent.
Rum.....	53.68 "
Gin, common.....	51.60 "
Gin, Hollands.....	55.44 "
Scotch whisky.....	54.32 "
Irish whisky.....	73.70 "
Common whisky.....	42.95 "

Of this class of liquors we find from over two-fifths to nearly three-fourths to consist of alcohol. Besides the water mingled with the alcohol there are other ingredients found, especially in the fermented liquors, as the hops in beer, juniper in ale, acids in wine and cider, etc. It is a common opinion that the effects of these various drinks on the human system are modified by the presence of these foreign substances; but it is quite doubtful whether these extraneous substances in the quantities in which they are used ever have any marked effect on the system. The various effects resulting from the use of the different kinds of drinks is more likely the result of the different degrees of dilution with water that characterize them, or of the manner in which they are taken. If taken in considerable quantities at once the effect will necessarily be more marked than if the same quantity is taken gradually so that it may be gradually taken up and disposed of by the system. In treating of the effect of alcohol on the human system no distinction will be made as to the kinds of liquors which contain the alcohol used. These effects are produced by two different processes, a chemical and a physiological one. Its most important chemical property is to arrest and prevent decomposition in all organic bodies, whether animal or vegetable. For this reason it is largely used for the purpose of preserving natural history specimens in the cabinets of scientists. In its antiseptic properties it is excelled only by creosote, carbolic acid, and arseniate of soda; but it has advantages over all these and is more generally used. When taken into the stomach with food it prevents the decomposition of the food under the action of gastric juices, and hence it tends to retard digestion and is detrimental to health.

But as digestion must proceed that life may be preserved,