THE ELECTRO-MAGNETIC TELEPHONE TRANSMITTER.

AN interesting contribution was made by M. Mercadier in a recent number of the *Comptes Rendus de l'Académie Française*. On the ground of some novel and some already accepted experimental evidence, M. Mercadier holds that the mechanism by virtue of which the telephonic diaphragms execute their movements is analogous to, if not identical with, that by which solid bodies of any form, a wall for instance, transmit to one of their surfaces all the vibratory movements of any kind which are produced in the air in contact with the other surface. It is a phenomenon or resonance. Movements corresponding to particular sounds may be superposed in slender diaphragms, but this superposition must necessarily be disturbing under all but exceptional circumstances. In proof of this view, it is cited that diaphragms much too rigid, or charged with irregularly distributed masses over the surface, or pierced with holes, or otherwise evidently unfitted for the purpose, are available for transmission. They will likewise serve when feathers, wool, wood, metals, mica, and other substances to the thickness of four inches are placed between the diaphragm and the source of vibratory movement. The magnetic field does not alter these relations in any way. The real diaphragm may be removed altogether. It is sufficient to replace it by a few grains of iron filings thrown on the pole covered with a piece of pasteboard or paper. Such a telephone works distinctly although feebly; but any slender flexible disk, metallic or not, spread over across the opening of the cover of the instrument, with one or two tenths of a gramme (three grains) of iron filings, will yield results of increased and even ordinary intensity. This is the iron filing telephone, which is reversible; for a given magnetic field there is a certain weight of iron filings for maximum intensity. It appears thus that the advantage of the iron diaphragm over iron filings reduces itself to presenting in a certain volume a much more considerable number of magnetic molecules to the action of the field. The iron diaphragm increases the telephonic intensity, but it is by no means indispensable.

ON ELECTRO-DISSOLUTION, AND ITS USE AS REGARDS ANALYSIS.

By H. N. WARREN, Research Analyst.

ON the same principle that electro-dissolution is used for the estimation of combined carbon in steel, etc., I have lately varied the experiment by introducing, instead of steel, iron containing a certain percentage of boron, and, having connected the respective boride with the positive pole of a powerful battery, and to the negative a plate of platinum, using as a solvent dilute sulphuric acid, I observed, after the lapse of about twelve hours, the iron had entirely passed into solution, and a considerable amount of brownish precipitate had collected at the bottom of the vessel, intercepted by flakes of graphite and carbon; the precipitate, having been collected on a filter paper, washed, and dried, on examination proved to be amorphous boron, containing graphite and other impurities, which had become chemically introduced during the preparation of the boron compound. The boron was next introduced into a small clay crucible, and intensely heated in a current of hydrogen gas, for the purpose of rendering it more dense and destroying its pyrophoric properties, and was lastly introduced into a combustion tubing, heated to bright redness, and a stream of dry carbonic anhydride passed over it, in order to separate the carbon, finally pure boron being obtained.

In like manner silicon-eisen, containing 9 per cent. of silicon, was treated, but not giving so satisfactory a result. A small quantity only of silicon separates in the uncombined form, the greater quantity separating in the form of silica, SiO_2 , the amorphous silicon so obtained apparently being more prone to oxidation than the boron so obtained.

Ferrous sulphide was next similarly treated, and gave, after the lapse of a few hours, a copious blackish precipitation of sulphur, and possessing properties similar to the sulphur obtained by dissolving sulphides such as cupric sulphide in dilute nitric acid, in all other respects resembling common sulphur.

Phosphides of iron, zinc, etc., were next introduced, and gave, besides carbon and other impurities, a residue containing a large percentage of phosphorus, which differed from ordinary phosphorus with respect to its insolubility in carbon disulphide, and which resembled the reaction in the case with silicon-eisen rather than that of the boron compound, inasmuch that a large quantity of the phosphorus had passed into solution.

A rod of impure copper, containing arsenic, iron, zinc, and other impurities, was next substituted, using hydrochloric acid as a solvent in place of sulphuric acid. In the course of a day the copper had entirely dissolved and precipitated itself on the negative electrode, the impurities remaining in solution. The copper, after having been washed, dried, and weighed, gave identical results with regard to percentage with a careful gravimetric estimation. I have lately used this method, and obtained excellent results with respect to the analysis of commercial copper, especially in the estimation of small quantities of arsenic, thus enabling the experimenter to perform his investigation on a much larger quantity than when precipitation is resorted to, at the same time avoiding the precipitated copper carrying down with it the arsenic. I have in this manner detected arsenic in commercial copper when all other methods have totally failed. I have also found the above method especially applicable with respect to the analysis of brass.

With respect to ammoniacal dissolution, which I will briefly mention, a rod composed of an alloy of copper and silver was experimented upon, the copper becoming entirely dissolved and precipitating itself on the platinum electrode, the whole of the silver remaining suspended to the positive electrode in an aborescent form. Arsenide of zinc was similarly treated, the arsenic becoming precipitated in like manner on the platinum electrode. Various other alloys, being experimented upon, gave similar results.

I may also, in the last instance, mention that I have found the above methods of electro-dissolution pecu-

liarily adapted for the preparation of unstable compounds such as stannic nitrate, potassic ferrate, ferric acetate, which are decomposed on the application of heat, and in some instances have succeeded by the following means of crystallizing the resulting compound obtained.—*Chem. News*.

A NEWLY DISCOVERED SUBSTANCE IN URINE.

DR. LEO's researches on sugar in urine are interesting, and tend to correct the commonly accepted views on the subject. Professor Scheibler, a chemist well known for his researches on sugar, has observed that the determination of the quantity of that substance contained in a liquid gives different results, according as it is done by Trommer's method or with the polariscope. As sugar nowadays is exclusively dealt with according to the degree of polarization, this fact is of enormous value in trade. Scheibler has isolated a substance that is more powerful in that respect than grape sugar. Dr. Leo's researches yield analogous results, though in a different field. He has examined a great quantity of diabetic urine after three different methods, namely, Trommer's (alkaline solution of copper); by fermentation; and with the polarization apparatus. In many cases the results agreed, while in others there was a considerable difference.

He succeeded in isolating a substance corresponding in its chemical composition to grape sugar, and also a carbo-hydrate differing considerably from grape sugar, and turning the plane of polarization to the left. The power of reduction of this newly discovered substance is to that of grape sugar as 1 : 2.48. Dr. Leo found this substance in three specimens of diabetic urine, but it was absent in normal urine, although a great amount was examined for that purpose. From this it may be concluded that the substance does not originate outside the organism, and that it is a pathological product. The theory of Dr. Jaques Meyer, of Carlsbad, that it may be connected with obesity, is negated by the fact that of the three persons in whom this substance was found, only one was corpulent.

FURNACE FOR DECOMPOSING CHLORIDE OF MAGNESIUM.

THE problem of decomposing chloride of magnesium is one which has attracted the attention of technical chemists for many years. The solution of this problem would be of great importance to the alkali trade, and, consequently, to nearly every industry. The late Mr. Weldon made many experiments on this subject, but

without any particular success. Of late a furnace has been patented in Germany, by A. Vogt, which is worked on a principle similar to that applied to salt cake furnaces; but with this difference, that in place of the pot it has a revolving drum, and instead of the roaster a furnace with a number of shelves. The heating gases are furnished by a producer, and pass from below upward over the shelves, S, then through the channel, C, into the drum, D, which contains the concentrated chloride of magnesium. When the latter has solidified, but before being to any extent decomposed, it is removed from the drum and placed on the top shelf of the furnace. It is then gradually removed one shelf lower as the decomposition increases, until it arrives at the bottom shelf, where it is completely decomposed in the state of magnesia, which is emptied through, E. The drum, D, after being emptied, is again filled with concentrated solution of chloride of magnesium. The hydrochloric acid leaves through F and G. If, instead of hydrochloric acid, chlorine is to be evolved, it is necessary to heat the furnace by means of hot air, as otherwise the carbonic acid in the gases from the generator would prevent the formation of bleaching powder. The air is heated in two regenerating chambers, which are placed below the furnace.—*Industries*.

THE FILTRATION AND THE SECRETION THEORY.

AT a recent meeting of the Physiological Society, Dr. J. Munk reported on experiments instituted by him in the course of the last two years with a view of arriving at an experimental decision between the two theories of the secretion of urine—the filtration theory of Ludwig and the secretion theory of Heidenhain. According to the first theory, the blood pressure prescribed the measure for the urine secretion; according to the second theory, the urine got secreted from the secretory epithelial cells of the kidneys, and the quantity of the matter secreted was dependent on the rate of movement of the circulation of the blood. The speaker had instituted his experiments on excised but living kidneys, through which he conducted defibrinated blood of the same animals, under pressures which he was able to vary at pleasure between 80 mm. and 190 mm. Fifty experiments on dogs whose blood and kidneys were, during the experiment, kept at 40° C., yielded the result that the blood of starving animals induced no secretion of urine, which on the other hand showed itself in copious quantities where normal blood was conducted through the kidney. If to the furnished blood was added one of the substances contained as ultimate products of digestion in the blood, such, for example, as urea, then did the secretion ensue.

The fluid dropping from the ureter contained more urea than did the blood. That fluid was therefore no filtrate, but a secretion. An enhancement of the pressure of the blood flowing through the kidney had no

influence on the quantity of the secretion passing away. An increased rate of movement on the part of the blood, on the other hand, increased in equal degree the quantity of urine. On a solution of common salt or of mere serum sanguinis being poured through the kidney, no secretion followed. All these facts, involving the exclusion of the possibility of a central influence being exercised from the heart or from the nervous system on the kidneys, were deemed by the speaker arguments proving that the urine was secreted by the renal epithelial cells. A series of diuretics was next tried, in order to establish whether they operated in the way of stimulus centrally on the heart or peripherally on the renal cells. Digitalis was a central diuretic. Common salt, on the other hand, was a peripheral diuretic. Added in the portion of 2 per cent. to the blood, it increased the quantity of urine eight to fifteen fold. Even in much less doses, it was a powerful diuretic. In a similar manner, if yet not so intensely, operated saltpeter and caffeine, as also urea and pilocarpine. On the introduction, however, of the last substance into the blood, the rate of circulation was accelerated in an equal measure as was the quantity of urine increased, so that in this case the increase in the quantity of urine was, perhaps, exclusively conditioned by the greater speed in the movement of the blood. On the other hand, the quantity of secreted urine was reduced when morphine or strychnine was administered to the blood. In the case of the application of strychnine, the rate in the current of the blood was retarded in a proportion equal to the reduction in the secretion of the urine.

The speaker had, finally, demonstrated the synthesis of hippuric acid and sulphate of phenol in the excised kidney as a function of its cells, by adding to the blood pouring through the kidney, in the first place, benzoic acid and glycol; in the second place, phenol and sulphate of soda. In order that these syntheses might make their appearance in the excised kidney, the presence of the blood corpuscles was not necessary, though, indeed, the presence of oxygen in the blood was indispensable.

VARYING CYLINDRICAL LENS.

By TEMPEST ANDERSON, M.D., B.Sc.

THE author has had constructed a cylindrical lens in which the axis remains constant in direction and amount of refraction, while the refraction in the meridian at right angles to this varies continuously.

A cone may be regarded as a succession of cylinders of different diameters graduating into one another by exceedingly small steps, so that if a short enough portion be considered, its curvature at any point may be regarded as cylindrical. A lens with one side plane and the other ground on a conical tool is therefore a concave cylindrical lens varying in concavity at different parts according to the diameter of the cone at the corresponding part. Two such lenses mounted with axes parallel and with curvatures varying in opposite directions produce a compound cylindrical lens, whose refraction in the direction of the axes is zero, and whose refraction in the meridian at right angles to this is at any point the sum of the refractions of the two lenses. This sum is nearly constant for a considerable distance along the axis so long as the same position of the lenses is maintained. If the lenses be slid one over the other in the direction of their axes, this sum changes, and we have a varying cylindrical lens. The lens is graduated by marking on the frame the relative position of the lenses when cylindrical lenses of known power are neutralized.

Lenses were exhibited to the Royal Society, London, varying from 0 to -6 DCy, and from 0 to +6 DCy.

THE LAWS OF THE ABSORPTION OF LIGHT IN CRYSTALS.

By H. BECQUEREL.

1. THE absorption spectrum observed through a crystal varies with the direction of the rectilinear luminous vibration which propagates itself in this crystal. 2. The bands or rays observed through the same crystal have, in the spectrum, fixed positions, their intensity alone varying. 3. For a given band or ray there exist in the crystal three rectangular directions of symmetry, according to one of which the band generally disappears, so that for a suitable direction of the luminous vibrations the crystal no longer absorbs the radiations corresponding to the region of the spectrum where the band question appeared. These three directions may be called the principal directions of absorption, relative to this band. 4. In the orthorhombic crystals, by a necessary consequence of crystalline symmetry, the principal directions of absorption of all the bands coincide with the three axes of symmetry. We may thus observe three principal absorption spectra. In uniaxial crystals the number of absorption spectra is reduced to two. 5. In clinorhombic crystals one of the principal directions of absorption of each crystal coincides with the only axis of symmetry; the two other principal rectangular directions of each band may be found variously disposed in the plane normal to this axis. Most commonly these principal directions are very near to the principal corresponding directions of optical elasticity. 6. In various crystals the characters of the absorption phenomena differ strikingly from those which we might expect to find after an examination of the optical properties of the crystal. We have just seen that in clinorhombic crystals the principal absorption directions of certain bands were completely different from the axis of optical elasticity of the crystal for the corresponding radiations. If we examine this anomaly, we perceive that the crystals manifesting these effects are complex bodies, formed of various matters, one, or sometimes several, of which absorb light and give each different absorption bands. Now, M. De Senarmont has shown that the geometric isomorphism of certain substances does not necessarily involve identity of optical properties, and in particular in the directions of the axes of optical elasticity in relation to the geometric directions of the crystal. In a crystal containing a mixture of isomorphous substances, each substance brings its own influence, which may be made to predominate in turn according to the proportions of the mixture. We may, therefore, admit that the molecules of each substance enter into the crystal retaining all the optical properties which they would have if each crystallized separately. The