to say, of previously radiant auroræ. I may also here state that the large purple auroral clouds peculiar to this phenomenon, when observed during considerable electrical disturbances in southern climes, I have never seen at Kautokeino.

Of quite a different nature is, however, the phenomenon which I have named "coruscation." This phase of the aurora, which almost without exception belongs to the earliest hours of the morning, and after large and extended oscillations of the aurora, is developed, I believe, by the luminous clouds. But while these remain quiet, or show at least subdued oscillations, the "coruscation," as I term it, is so violent and of such a peculiar nature that I have not even yet succeeded in ascertaining whether the motion is horizontal or vertical, or whether it is the luminous clouds themselves which flood the heavens, or their merely momentary "blazing up" under the influence of some passing waves of energy. The entire heaven is sometimes for hours a bath of liquid fire by this force, which seems, by the bye, to possess the same remarkable rapidity around zenith as at lower elevations.

As regard the colors of the auroræ, I have only noticed, when the substance of light is great, and when the oscillations are very rapid, two well known forms, viz., green and red. These are, however, only seen in the arcs at their lower rim, and by the forward movement one part assumes a red, another a green tint. The red color sometimes changes into violet or ochre.

The spectroscope I have not had much opportunity of using here, but the well known auroral "line" I can always see; any others I have not observed.

With regard to the height of the aurora I have, judging from observation, come to the conclusion that it does not appear at a lower elevation here than it does in the south of Norway, while I am convinced that its plane is to be found far above that of the clouds. There has often enough been an opportunity of observing auroræ and clouds simultaneously, but never has there been the slightest indication of the auroræ having descended to the sphere of the clouds, not even under the most violent oscillations and the most intense luminosity and play of color. In fact, I have come to the conclusion that the auroræ which I have watched at Kautokeino are identical with those I have studied in southern latitudes, while their plane is at the elevation which I estimated when choosing Kautokeino as my station of observation.

I may in conclusion state that I have never myself heard the slightest approach to any auroral "noise," and this in spite of my most earnest attention to this so much disputed question. Still, if I ask the native people (Lapps) about here as to the "noise," there is not a single one who doubts its existence, while several even assert that they have heard it.

I have several times attempted to photograph the aurora borealis, but without success. Thus, even by using the most sensitive English "dry" plates, and exposing them from five to seven minutes, I have not obtained a trace of a negative. The cause of this is, I believe, the exceedingly limited substance of light possessed by the auroræ: were thus even the entire heavens flooded by the most intense auroræ, their aggregate lighting capacity would not equal that of the moon when full. I may therefore assume that photographing the aurora borealis is an impossibility.

SOPHUS TROMHOLT.

Kautokeino, Finmarken, Norway, January 28, 1883.

ELECTRIC ILLUMINATION BY REFLECTION.

D. V. PARTZ exhibited a plan of a new mode of electric lighting, at the French Electric Exposition. The light was placed in chambers underneath the street, and reflected through hollow cylinders, enameled on the inside, so as to produce an inverted cone of rays, which strike a reflector placed at a height of 40 or 50 meters above the street. Among the advantages which are claimed by the inventor are: The employment of powerful electric foci, thus avoiding the loss which results from the division of the current; the equal diffusion of the light and the avoidance of the dazzling glare; the diminution of the loss of light which results from the employment of translucent globes; the readiness of access for regulation and surveillance; and the illumination of thick mists, which can be penetrated with difficulty by other methods.—*La Lumière Electrique*.

PERFECT INTERFERENCE OF SOUND BY TELEPHONE.

SUPPOSE we have two telephones having the poles of their magnets similarly placed, and so connected with a circuit that a current will traverse their coils in the same direction. It is evident that any electric current passing will cause a simultaneous movement in the same direction in the diaphragms of both telephones. Now, if we conceive the current reversed in one of the telephones, the motions will have opposite signs. It follows, then, that the currents due to the vibration of the diaphragm of a third telephone in the circuit will produce in the two telephones vibrations of opposite phases; the sounds produced, therefore, will differ by a half wave length. The same current which in one telephone produces a condensation will in the other produce a rarefaction.

The experiment, as successfully tried in the physical laboratory of Dartmouth College by Professor Emerson and myself, was arranged as follows: the mouths of two similar telephones were placed before the extremities of a Y-shaped tube, and the sound from both telephones conducted to the ear by rubber tubing. A reversing switch was placed in the circuit, by means of which the direction of the current in one of the telephones could be changed; in this way could be produced at will coincidence or interference of sound. Each branch of the Y-tube was of rubber, so that either arm could be closed by pinching. Organ pipes of various lengths were sounded near a telephone in a neighboring building. It was found that, when arranged for interference, the pinching of either of the branch pipes produced a very decided increase in the intensity of the sound; when reversed, an equally decided decrease. The inequality in the intensity of the sounds due to the two telephones was found to be the chief difficulty in producing complete interference; but by partly closing one branch, so as to weaken the stronger sound, the effect was much improved. In several trials the interference was complete, no sound whatever being audible. The rapid reversal by the switch gave a sharp contrast between the strengthening and the weakening effect.

This method of demonstrating the phenomenon of interference has obviously the advantage of applicability to sounds of any pitch. With singing, the interference was very satisfactory, especially with the lower notes; in conversation, however, the sound is not so much weakened, but the quality is perceptibly changed. The vowels seemed to suffer much more than the consonants.—*C. S. Cook, in Science*.

A NEW TELEPHONE RECEIVER.

THE monopoly of telephone business acquired by the United Telephone Company (albeit at a very heavy cost for patents) has had that effect upon the commercial and scientific progress of telephony which usually attends such monopolies. A company with a huge capital finds, as a rule, little difficulty in overcoming its weak competitors, and as often as not it has the option of either buying or fighting them out of the market. Then, having the business in its own hands, it can charge its own price, and, generally speaking, conduct matters as it pleases. There is also to be observed a reluctance to adopt new forms of apparatus or machinery, preferring to progress the saving which results

from using up older and less perfect forms. One other consequence is that inventors, or would-be inventors, are oftener than otherwise discouraged, and so improvements which might possibly have proved to be great boons to the general body are lost, buried—may be for ages—in dense oblivion. This has, we fear, been our experience in matters telephonic. We have now, however, to chronicle the introduction of an instrument which, while it possesses the advantages of a Bell telephone, differs from it very materially, both in construction and principle, and threatens, therefore, if properly managed, to become a successful competitor of the older instrument. Even were it to do no more than bring down the price charged for the existing types, it will have accomplished a most valuable task.

The general construction of this new telephone receiver may be gathered from the accompanying diagrams, of which Fig. 1 represents the more essential parts of the instrument, with its connections. The instrument consists of a thin wire, A, of iron, steel, or other magnetic metal attached to two disks, DD, which may be of thin wood, metal, or other more or less sonorous material; on the wire, A, is wound in the first place an insulated conducting wire, W, completing the circuit of a local battery, B, in which circuit may be introduced any known telephonic transmitting instrument, T; also on the wire, A, is wound in the second place an insulated wire, X, forming part of the line circuit, LL', communicating with a distant station. When electrical impulses are set up in the line, LL', at the distant

station by a telephonic transmitter, sounds corresponding with those that caused the impulses are emitted by the instrument illustrated.

The principle involved here is easily understood. It is well known that when an iron wire or rod is magnetized, it suffers a slight increase in length, accompanied by a compensating decrease in its lateral dimensions or cross section. On the cessation of the current (or the removal of the inducing magnet) the iron returns to its latent magnetic condition, and a decrease in length results. This molecular effect is distinctly audible under favorable circumstances. Messrs. Alabaster, Gatehouse and Kempe take advantage of this fact in the construction of their receiver. The current from the

local battery, B, is continuous, and its effect upon the iron wire is, therefore, to make it practically a permanent magnet. When the current arrives from the distant station along the wire, LL', it in passing through the fine wire coil, X, induces a current in the thick wire coil, W, connected with the battery. The direction of the current induced in W varies, of course, with the current in the coil, X, and, accordingly, an increase or decrease in the strength of the battery current flowing through the coil, W, is produced, and the iron wire, A, is subjected to proportionately varying degrees of magnetization. The minute contractions and elongations so produced in A necessarily cause corresponding vibrations in the attached wooden diaphragms, DD, which perform in this way the function of sounding-boards to A.

The instrument may also be connected, as shown by Fig. 2, where the two disks, DD, form the ends of sound boxes, SS, having flexible tubes leading from them to funnel mouths, EE, that can be held to both ears. The wire, W, may also include in its circuit the primary coil of an induction coil, I, the other wire, X, including in its circuit the secondary coil of I. The gain effected by using the induction coil is to increase the effect upon the local battery current.

Fig. 3 shows a convenient form in which the instrument may be made. The iron wire, A, is, in this instance, inclosed in a wooden casing, C, to which one end of the wire may, or may not, be attached, the other end being attached to the single disk, D, which is clamped to the casing by an ear piece, M. This form is very light, its total weight being no more than four ounces.

As regards the efficiency of the instrument, we may say that it reproduces the sounds with remarkable clearness, even in this, its crudest form; and when the transmitter (which we are not yet at liberty to describe), as well as a further improved form of receiver, are placed before the public, we imagine that the result will fully indorse our sanguine anticipations.

It is as well, perhaps, to mention that the inventors of the receiver we have described make no general claim to the use of an iron or steel wire coiled with a conducting wire for producing sounds under the influence of electric currents, but claim—

"The construction of a telephonic receiving instrument consisting of a magnetic wire attached to a sonorous disk, or plate, and wound with a primary coil connected to a local battery, and with a secondary coil connected to the telephonic line wire, as described.—*Knowledge*.

ASBESTOS FILTERS.

By P. CASAMAJOR.

AN extensive dealer in wares used by chemists lately informed me that he had many inquiries concerning asbestos for filtering liquids in chemical analysis. Some chemists complain that they cannot get clear solutions though asbestos, while others, who obtain clear solutions, find that their liquids filter altogether too slowly.

Allow me to recall that the method of making asbestos filters, by pouring a thin paste of this material over a perforated platinum disk, was first proposed by me in 1875, but I neglected to give directions concerning the preparation of asbestos, to make it fit for filtering liquids in chemical analysis. It now appears, however, that such directions would be found useful, and I propose to repair the omission and give the necessary details.

The kind of asbestos to use is a matter of some importance. I have tried three kinds, which are sold by dealers in New York, as the *Canadian*, the *Italian*, and the *Australian*. This last is less flexible than the other two, and consequently the fibers do not felt together and pack as closely on the perforated plate. Hence liquids filter more rapidly, and the Australian is, on this account, preferable to the other two kinds. I am informed that the Canadian asbestos is the most soluble in acids, but I have not verified the assertion.

Whatever may be the kind of asbestos used, the following is a process for obtaining, with little trouble, a quantity of the pulp in a fit state for filtration:

A coarse brass sieve is placed over a sheet of paper, and a handful of asbestos is rubbed pretty roughly over the sieve cloth. This breaks it up in such a way that the smaller fragments pass through the meshes, and are deposited on the paper underneath. After a while the portion which remains on the sieve cloth is collected in one bundle, and rubbed again in the same manner, and the operation is repeated until a sufficient quantity has gone through. In a few minutes enough of the material is obtained to last for months.

As to the coarseness of mesh to use, I may say that I have used No. 10 sieve (ten openings to the inch) with satisfactory results. The sieve is best placed bottom up, so as to leave plenty of room under the cloth.

The next operation is to free the sifted material from dust, and from the finest particles. This is easily accomplished by placing the asbestos, as obtained above, over another sieve of finer mesh (about No. 25 or No. 30), and stirring it while water is poured over the sieve. The first water which passes through is quite milky, but it gradually becomes clearer as the washing is continued. The washed asbestos is then put in a beaker glass, and boiled for about half an hour with strong hydrochloric acid (about 1 part of fuming HCl to 4 parts of water).

The pulp, after this treatment, is poured over a perforated platinum plate placed in a funnel,* and washed with distilled water until no acidity is shown by litmus-paper. The pulp is then taken out of the funnel and strongly heated in a platinum dish. After letting it cool sufficiently, it may be placed in a wide-mouth bottle for future use.—*Chem. News*.

OXYGEN GAS FROM POTASSIUM CHLORATE.

By A. WAGNER.

COMMERCIAL potassium chlorate yields under all circumstances oxygen gas containing chlorine. Chemically pure chlorate yields oxygen free from chlorine if the action of carbonic acid or of organic matter is excluded. Carbonic acid, with the aid of heat, decomposes pure potassium chlorate in such a manner that chlorine is liberated. Organic substances act in a similar manner, and the residue has a strongly alkaline reaction. The presence of calcium chlorate also occasions the liberation of chlorine. The manganese ore used for the preparation of oxygen gas along with potassium chlorate not unfrequently contains an appreciable quantity of organic matter.

*A perforated platinum disk, having a stout platinum wire soldered with gold in the center of the disk can be used in an ordinary conical funnel. The wire finds its place in the stem of the funnel, and keeps the perforated plate in position. (See *Chemical News*, xli., p. 8.) A Gooch crucible of sufficient size may also be used for the same purpose.