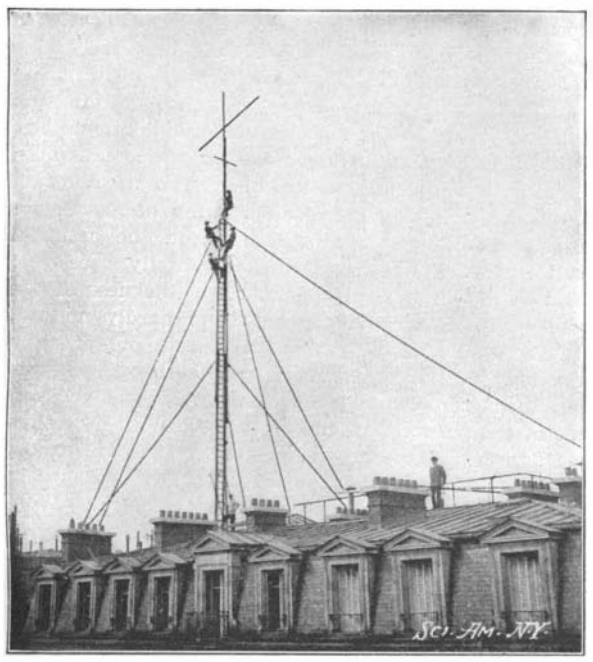
POPP-BRANLY AERIAL TELEGRAPHY SYSTEMS.

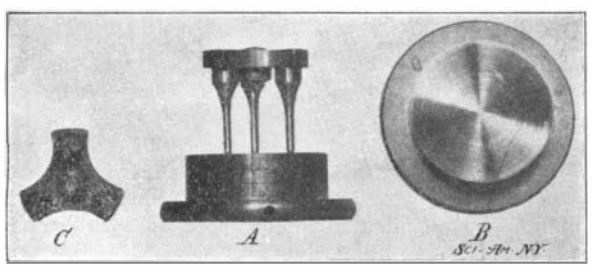
BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

An aerial telegraphy project of unusual interest is now being organized in Paris. It is the intention to establish a subscriber system which will cover the whole city, and the subscribers will be kept posted as



Mounting the Masts.

to all the important news of the day. A company has been formed for the purpose, which company is headed by Victor Popp, a prominent engineer and director of compressed air and electric lighting systems in Paris; with him is associated Dr. Edouard Branly whose work in aerial telegraphy is too well known to be dwelt upon. This company has already installed a station at its headquarters, Place de la Madeleine, and two others at the newspaper offices of the Figaro and Journal, besides a third at the Agence Havas,



Details of the New Branly Coherer.

A, tripod on base; B, base; C, tripod, end view.

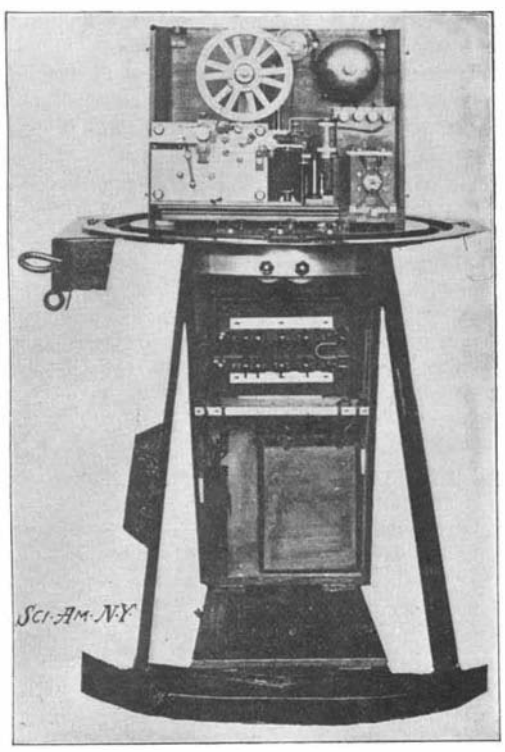
near the Bourse. For some months past messages have been regularly sent between these posts and there seems to be no question as to the practical operation of the system. Dr. Branly's newly improved instruments are used and the masts are mounted on the roofs of the buildings.

The execution of the subscriber system will no doubt be carried out shortly. For this purpose a main transmitting station will be established in a central locality, perhaps near the Bourse. This post will have ample telegraph and telephone facilities for receiving the news of all the important events of the day. As the news is received, the central post will transmit it in turn by aerial telegraphy to a series of receiving stations distributed throughout the city and suburbs. From these, cyclist messengers will carry the news to the subscribers' houses say every half hour. Thus the subscribers will be kept posted on all the leading events both of home and foreign news, stock quotations, markets, etc. The relatively small cost will place the system within the means of many persons. The system will be especially valuable for hotels, clubs, cafés, etc., which are to have bulletin boards for posting the news. The utility of such a system will be at once apparent, for it will greatly further the business interests of the city.

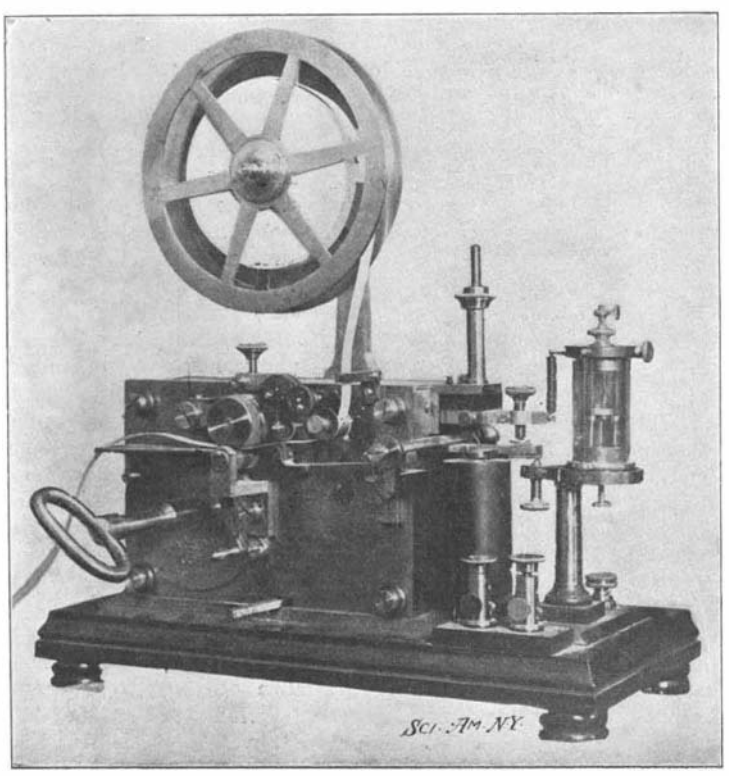
Among the instruments used, the new coherer and transmitting device has attracted considerable attention. M. Branly has lately discovered a new form of coherer which has several advantages over the ordinary type which uses a tube with metal filings. It is of a more solid construction and at the same time more sensitive; the most valuable improvement is the suppression of the tapper, which makes the whole apparatus considerably simpler. The principle of the new coherer is that of a contact between a polished and an oxidized metal surface, and as now constructed it has the form of a small tripod about an inch high resting upon a metal plate, as will be noticed in the engraving. The cohering action takes place between the ends of the three rods and the lower plate. The rods are of steel about ⅛ inch in diameter at the lower part and are united above by a circular metal plate. To the latter is connected one terminal of the circuit. The ends of the rods are first well cleaned and polished and are then given a slight coating of oxide by heating in a closed receptacle in a gas-furnace. It is necessary that the coating should be of a determined thickness and this is obtained by regulating the temperature of the furnace. The lower plate upon which these oxidized points rest is of steel and has a highly polished surface. The rods of the tripod are in parallel in the circuit. The engraving shows the tripod and lower disk; to the right is seen the polished surface of the latter and to the left the ends of the rods. The degree of oxidation of the points is an essential feature and upon it depends the sensitiveness of the coherer. This type has been found to be more sensitive than the tube with metal filings and experiments showed that it worked with a small spark over distances at which the filing coherer failed to respond regularly. Owing to its greater sensitiveness, voltages of ½ to 1 volt are used. After the decohering action takes place by a spark, a slight shock brings back the conductivity even when working on a closed circuit through a resistance. Under the usual conditions of open circuit a very slight shock is found to answer. The latter feature enabled the inventor to place the tripod directly upon the Morse receiving instrument and the shock is given by the striking action of the armature. This is a considerable improvement, as it simplifies the apparatus of the receiving station. The receiver may be also made to work more rapidly. One of the pictures shows the Morse receiver and tripod coherer to the left; the diagram shows the connections. A battery cell of ½ volt has one pole joined to the upper tapping screw of the receiver, *A*, and the current passes down through the screw to a platinum disk *P* fixed to the movable arm of the instrument. The disk is insulated and is connected by a flexible wire to a sensitive Claude relay, *R*, then to a variable resistance *r* and to the lower steel disk *D*. The tripod is connected to the battery, completing the circuit. The relay closes the second circuit, including two to four Leclanche cells and the receiver magnets. When a spark is sent from the transmitting station, the coherer acts and closes the relay circuit. When the relay acts it throws in the receiver magnet and the armature arm is drawn down. The platinum plate being separated from the screw, the relay circuit is opened and consequently the receiver circuit. Meanwhile the arm continues downward by its inertia and strikes the lower screw *B*. This screw is fixed in the platform which carries the coherer, as will be observed. The shock of the arm against the screw is sufficient to act upon the coherer and open the circuit. The spring then brings up the arm against the upper screw and the contact is established as before. It will be seen that by utilizing the action of the receiver to give the shock to the coherer, the independent tapping device is eliminated and the whole reduced to a simple form. Owing to the slight shock which is required for the coherer the play of the tapping arm may be reduced, resulting in an increased speed of reception. The tripod coherer is inclosed in a glass protecting cylinder and the whole is very compact, measuring but 2 inches high and 1½ inches in diameter. When not in use the tripod is lifted off the lower plate by turning an upper screw around which is wrapped a flexible wire connected to the tripod and answering at the same time for the current. The transmitting station, which has apparatus of the usual type, is shown in an engraving. On the left is the contact key and the motor operated interrupter for the induction coil. Above is the switchboard with instruments. The induction coil is contained in the right hand case, with a variable condenser below and the discharger mounted on top; the upper cable leads out to the mast.

A Transmitting-Post.

Besides the Paris system the company has a number of other projects under way. It is expected to establish a system of maritime posts all around the coast of France in order to communicate with vessels. At present two such posts are being erected on the north coast, one at Cape Gris Nez and a second at Cap de la Hague, and these are to be finished by the end of November.



Marine Receiver Mounted on Gimbals—Battery and Resistance-Box Below.



Morse Receiver with the New Branly Coherer.

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Others will follow and finally it is expected to cover the whole north and west coasts, as well as those of the Mediterranean. Later on the system will be extended to the French possessions in Africa, along the north coast from Algiers to Tunis and also on the west coast. It is proposed also to connect Madagascar with the mainland and from thence by telegraph with the north.

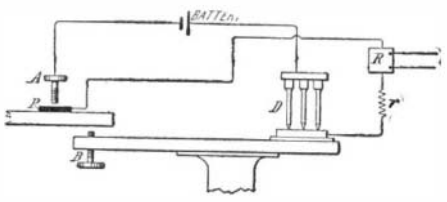

DIAGRAM OF THE RECEIVING SYSTEM.

M. Popp and Lieut. Monteil have a project for connecting Tunis with Lake Tchad across the Sahara by a succession of aerial telegraphy stations. The Lake Tchad station will connect to the projected telegraph lines extending to the existing Niger and the Congo systems.

Exhibition of Recent Scientific Inventions at the Royal Society, London.

Some interesting exhibits relating to recent inventions and discoveries in the various ramifications of scientific and electrical research have been on view in London at the rooms of the Royal Society of Great Britain.

An apparatus for the administration of chloroform, combined with air for the formation of an anæsthetic, the invention of Mr. A. Vernon Harcourt, was exhibited, the salient characteristic of which is that the chloroform may be administered without any apprehension of danger to the patient. In this contrivance there are two vessels, in one of which chloroform mixed with alcohol is placed, and in the other pure water, over the surface of which liquid air is drawn. When passing over the first vessel the air absorbs approximately 2 per cent of its volume of the chloroform and spirit, the latter of which mixture is absorbed by the water when passing over the second vessel, leaving only pure chloroform. The air with chloroform is then drawn through a third vessel, filled with a double-way cock, by which it is further diluted with any quantity of air to any desired extent. For the administration of the chloroform to the patient a special contrivance is placed over the mouth, which is fitted with two valves. One valve is connected to the vessel containing the chloroform and the patient when inhaling draws the chloroform from the vessel, and when exhaling, emits it through the second valve into the atmosphere.

The Hampson hydrogen liquefying apparatus was also shown. Hydrogen when compressed at ordinary temperature and then permitted to expand becomes warmer. This is a peculiar distinguishing feature of this gas. But if the hydrogen is compressed at a temperature below the normal and is then permitted to expand, instead of becoming warmer, it grows colder. In the Hampson apparatus the hydrogen in the gaseous state is passed under a pressure equivalent to 150 atmospheres through coils cooled by solid carbonic acid, liquid air at a temperature of 185 deg. Cent., and by liquid air boiling under reduced pressure at 200 deg. Cent., into the interior of the apparatus. The passage of the hydrogen through these coils considerably cools it, and in this state it enters a regenerating coil, and by expanding through a valve at the bottom of the coil becomes partially liquefied. The liquefied gas is caught into a vacuum vessel placed under the liquefying apparatus. That portion of the hydrogen which is not liquefied returns through the regenerating coil to the compressor, cooling the other gas as it passes. Liquefaction of the hydrogen is comparatively rapid—about a pint being obtained in the course of half an hour. Dr. Travers, who exhibited the Hampson apparatus, has determined the melting point of hydrogen to be 14.1 deg. absolute.

Another ingenious contrivance was Prof. H. L. Callendar's apparatus for ascertaining the mechanical equivalent of heat, an invaluable device for engineers. It consists of a brass cylinder 6 inches in diameter by 2 inches in length. This vessel is half filled with water and is kept revolving by an electric motor. A brake strap composed half of silk and half of leather with a floating weight at each end is placed around the periphery. The means of keeping the weights afloat is very ingenious. When the coefficient of friction increases, the strap slips round the cylinder, bringing the silk portion into contact with the latter, and the immediate result is a diminution of friction. On the other hand, if the coefficient of the friction decreases, the strap slips round the cylinder in the reverse direction until the leather is brought into contact with the cylinder, when the friction is increased. By this alternate increase and decrease of the length of the respective materials upon the cylinder, the position of equilibrium can be soon ascertained, and the exact number of foot pounds exerted may be determined by calculating the weights and rotating velocity. The temperature is recorded by means of a platinum thermometer.

Some experiments were also carried out to illustrate certain phenomena. One of the most interesting was an artificial production upon a small scale of the aurora borealis by Prof. W. Ramsay. To produce this remarkable phenomenon, a powerful electro-magnet is placed in a vertical position, and pole pieces extend from both the upper and lower ends of the magnet in a horizontal direction. Between the pole pieces is placed an exhausted glass globe containing an annular ring in its upper part. A powerful alternating current is discharged through the ring in the glass sphere, producing an annular glow discharge. When a current is directed through the coils of the electro-magnet the annular glow discharge in the globe is deflected downward in the form of streamers, very similar to those of the aurora borealis. As is well known, investigations of the spectrum of the aurora borealis have conclusively proved the presence of krypton in the phenomenon, and Prof. Ramsay practically illustrated this discovery by filling the globe with highly rarefied air, which immediately resulted in the production of the krypton in the discharge.

Prof. Johnstone Stoney, F. R. S., comprehensively illustrated the interference between portions of light from independent sources. A broad sodium flame was reflected by lenses upon a diffraction grating with 26,000 reflecting strips. A slit was then interposed, but parts of the light which fell upon widely separated strips of the grating, emanated from different parts of the flame, and in phases and polarization conditions, were not related to one another. Yet the portions of light reflected from these strips interfered with one another, resulting in the same distribution of light, and the spectra produced was in every way as pure as if the reflection of the flame had fallen upon the slit instead of upon the grating. Also, no matter to what width the slit was adjusted, the definition of the *D* lines of the spectrum of the second order was remarkably clear. In another experiment Prof. Johnstone Stoney threw the image of a flat flame upon a microscopic diatom with hexagonal markings, and a large number of circular spectra were observed gathered around a common center.

A very interesting experiment was also shown of a paradoxical consequence of the wave theory of light. It is a well-known fact that if a ray of light falls upon a right-angled prism of the conventional type, the light is totally reflected at the internal surface of the hypothenuse and emerges at the other rectangular face. But at the same time the hypothenuse surface must be perfectly clear, otherwise the light will not penetrate it. This latter condition was proved by an interesting experiment carried out by Messrs. Edser and Senior. They used a prism, the hypothenuse surface of which was marked with a photographic diffraction grating of 3000 lines to the inch, the rules being parallel to the axis of the prism. When this lined hypothenuse face was exposed to a ray of light, the latter was not reflected at the face, but a considerable portion passed out through the grating resulting in brilliant diffraction spectra.

The Structure of Glacier Ice.

Mr. J. Y. Buchanan, the well-known scientist who has made extended study of the structure of glacier ice, principally from the Aletsch Glacier, has found that the weight of the individual grains of ice varies considerably. The fragments of this glacier which float as icebergs in the Mergelin Sea are exposed to the powerful weathering of the summer sun, and are comparatively easily dissected into their constituent grains. A number of blocks were so dissected in order to ascertain the weight and size of the largest grains, when the following weights of single grains were determined: 700, 590, 450, 270, 255, 170, 150 and 100 grammes. The blocks of ice contained grains of all sizes which fitted each other so exactly that in the fresh unweathered block the whole volume was filled with ice.

The sun's rays on glacier ice accomplishes a dual operation—it disarticulates the ice into its constituent grains, and it splits the individual grain into laminæ perpendicular to the principal axis of the crystal, and bounded by the planes of fusion as discovered and described by Tyndall. These planes are the distinguishing characteristic of the individual ice grain. Under the influence of radiant heat an ice crystal begins to melt at the surfaces which separate these laminæ, and the process of disintegration and decay is directed by their plane. On the other hand, an ice crystal floating in water and losing heat generates ice laminæ, which are directed by the same planes and which form the continuation of the corresponding laminæ of the parent crystal. This was well observed during the Mergelin Sea observations. Every night a thin skin of ice was formed at the shallow end of the lake where the ice blocks collected. As the grains in a block of glacier ice are distributed quite irregularly, the water line of a floating block necessarily cuts a great number of grains, all of which are oriented differently. The ice crystals which were formed during the night along this line were oriented each one by the grain with which it was in contact, and from which it appeared to spring in continuation of its crystalline laminæ.

The disarticulating and analyzing action of sun's rays is not accomplished without the selection and expenditure of energy. Accordingly it is observed that one grain protects another. It is only the grains that are exposed to the sky, and above water, that are so analyzed, and prolonged exposure of this kind reduces a grain to the last stage of dilapidation. The grains beneath the surface, whether of ice or water, are almost completely unattacked. The necessity of direct sky light for the disarticulation of glacier ice into its constituent grains is seen in the artificial grottoes which are maintained at easily accessible parts of most popular glaciers. The thickness of the softened ice is so trifling that it is hardly noticed, and the whole grotto appears to be cut out of clear blue ice. If the observer on penetrating for a few feet, turns round and looks outward he sees the surface of the ice walls of the grotto etched with strange line figures. These are most strongly marked at the opening, and they cease exactly at the spot where the last ray of direct sky light strikes the ice. Were it not for the fact that a glacier is made up of distinct grains of ice, and that this substance has the property of melting and freezing at different temperatures, according to the composition of the water with which it comes in contact and to the pressure to which it is subjected, there is little doubt that a glacier would be as motionless as any other mass of crystalline rock.

Trial of the "Adder" and "Moccasin."

The latest Holland submarine boat "Adder" had her trial trip on the afternoon of November 11. After some preliminary work she dived, and while submerged made eight round trips over a quarter of a mile course. She was made to perform various evolutions, such as rising to the surface, dropping deeper, diverging in both directions and turning in a short space. The speed test showed that when submerged she could make 7.23 miles an hour, which is nearly one-fourth of a knot over the contract requirements. On November 12 the "Adder," in conjunction with the "Moccasin," was submitted to another test. The required conditions were four runs awash under one, two, three, and four cylinders respectively. The first half-mile was made in 5 minutes 45 seconds, the second in 3 minutes 50 seconds, the third in 3 minutes 30 seconds, and the fourth in 2 minutes 55 seconds, showing an increase of speed as each cylinder was added.

The second trial was with the boat in light condition. Six runs were made over the course, half with and half against the wind. The times taken were as follows: First, 4 minutes 19 seconds; second, 4 minutes; third, 3 minutes 36 seconds; fourth, 3 minutes; fifth, 3 minutes 15 seconds; sixth, 2 minutes 53 seconds. At noon the observers on shore reported that the "Adder" had exceeded her contract speed easily.

In the afternoon the "Moccasin's" light trial took place. It consisted of three half-mile runs against the wind and three with it. While the "Moccasin" did not make as fast time in some of her runs as the "Adder," she was, on the whole, considered steadier. Her times were: First, 8 minutes 40 seconds; second, 5 minutes 5 seconds; third, 4 minutes; fourth, 3 minutes 5 seconds; fifth, 3 minutes 27 seconds; sixth, 3 minutes 35 seconds.

Both boats exceeded their contract speed of 7 knots under awash and 8 knots under light conditions by more than half a knot.

The Trial of the Lebaudy Airship.

The airship built for Pierre and Paul Lebaudy was tried near Nantes on November 13. Several free ascents and descents were made. The flying machine, after making revolutions in every direction over fields and woods bordering the Seine between La Roche, Guyon and the town of Bonnières, returned each time to its point of departure. The Lebaudy ship is similar in appearance but twice the size of the airships of Santos-Dumont. The machine was first tried on November 8, when it was successfully operated for half an hour.

At the recent opening of the Copenhagen Exhibition, a letter was made public from Thomas A. Edison on the future of electric traction. Mr. Edison asked as to his opinions concerning electric traction and aerial navigation replied: "I believe that within thirty years nearly all railways will discard steam locomotives and adopt electric motors, and that the electric automobile will displace the horse almost entirely. In the present state of science, there are no known facts by which one could predict any commercial future for aerial navigation."