

# BELIN'S IMPROVED APPARATUS FOR THE ELECTRICAL TRANSMISSION OF PICTURES.

BY JACQUES BOYER.

The SCIENTIFIC AMERICAN of December 21st, 1907, contained a description of the tele-photographic process invented by Edouard Belin. The object of this first tele-stereograph, as the inventor calls the apparatus, like that of the improved form now to be described, was to transmit and reproduce photographically all drawings and pictures in relief. In this first experimental apparatus, which gave some very encouraging results, the transmitting and receiving stations were mounted on one table and driven by the same motor. The fictitious distance between them was represented by a resistance equal to that of 750 miles of telephone wire. Furthermore the two stations did not possess the apparatus which is required for photographic transmission to great distances over actual telephone circuits.

The new apparatus, here illustrated, was experimentally used with success between Paris and Lyons in January of this year. The two stations, now separated, are operated simultaneously by an electrical device which insures synchronism. These stations are absolutely identical, and either may be adapted for receiving or transmitting by moving a switch.

The process of transmission is based upon the fact that a photographic print in bichromated gelatin presents, even when dry, a series of elevations and depressions, and that some other prints have the same peculiarity. The white parts of the picture are represented by the deepest depressions; and the blacks by the highest elevations, while the half tints are represented by intermediate thicknesses of gelatin, in exact accordance with their depth of tint. The photographic print is affixed to a cylinder which rotates before a tracing point carried by the short arm of lever. The long arm of this lever carries a little wheel which rolls upon a diminutive rheostat formed of plates of silver alternating with sheets of mica, the thickness of the whole being only 1/10 inch. Each silver plate is connected with the junction between two consecutive coils of a resistance box, such as is used in physical laboratories. The first coil represents the resistance of the line, and the other coils are so calculated that their successive intercalation produces a uniform decrease in current strength.

The tracing point travels over the surface of the cylinder in a spiral line, and the lines thus formed are 1/6, 1/5, or 1/4 of a millimeter (1/150, 1/125, or 1/100 inch) apart, the change from one system to another being made by a simple mechanical adjustment.

The diameter and length of the cylinder are such that it is covered by a print measuring about 4 by 5 1/2 inches.

The receiving station is composed essentially of:

1. A Blondel oscillograph which is connected with the line wire and translates the fluctuations of the current into oscillations of a beam of light, reflected by a small mirror.

2. A rectangular box, shown in profile in one of the

photographs, in which the receiving cylinder rotates. This cylinder, corresponding in dimension with the transmitting cylinder, carries the photographic film or paper upon which the transmitted picture is impressed.



Fig. 1.—A portrait transmitted from Lyons to Paris in 5 1/3 minutes by the new Belin telestereograph.

In the wall of the box opposite this film is a circular opening of a diameter of 1/6, 1/5, or 1/4 millimeter, according to the scheme employed.

3. A Nernst lamp provided with a lens, which condenses its rays upon the mirror of the oscillograph.

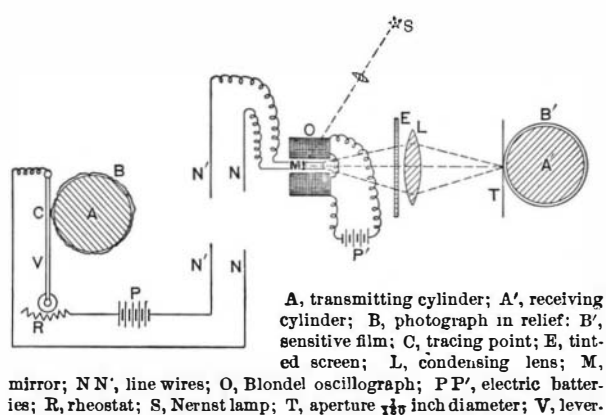


Fig. 4. Diagram illustrating the operation of the Belin telestereograph.

4. An aplanatic lens which converges upon the sensitive film the rays reflected by the mirror. The mirror and the point of incidence on the film are conjugate foci of this lens.

5. A screen of graduated tints placed in front of the lens.

With the aid of this description and the accompanying diagram the operation of the system will be easily understood.

When the apparatus is started the elevations and depressions of the picture at the transmitting station impress continuous oscillatory movements upon the tracing point, and consequently upon the little wheel at the other end of the lever. When the wheel, as a result of these movements, is at one side of the rheostat, no resistance is added to that of the line and the current is a maximum. When the wheel is at the other side of the rheostat all the additional resistances are inserted and the current is a minimum. In intermediate positions the strength of the current is a function of the position and the variations thus produced are rigorously proportional to the elevations and depressions and consequently to the variations of tint of the original picture; hence, on reaching the receiving station the fluctuations of this current impress upon the mirror of the oscillograph rapid successive deviations proportional to the varying strength of the current. In consequence of these deviations the reflected pencil of light oscillates from right to left and from the center to the edge of the lens after traversing the graded screen, the function of which is to reduce the luminous intensity more or less, according to the position of the pencil. As the film and the mirror are at conjugate foci, the aperture in the box is continuously illuminated. Hence when the luminous pencil falls upon the center of the lens the absolute transparency of the screen at this point produces no diminution, and the impression is a maximum, producing a black spot in the photograph. When the luminous pencil falls on the edge of the lens the absolute opacity of the screen at this point entirely extinguishes the light and a white spot in the photograph results. In every other position of the reflected beam a partial extinction by the tinted screen produces the photographic effect desired; and the combination of all these effects produces a picture entirely similar to the original, and having all its detail, down to a fineness of 1/6, 1/5, or 1/4 of a millimeter (1/150, 1/125, or 1/100 inch) according to the system used.

It is very evident that if the tints are correctly graded and the sensitiveness of the oscillograph is properly adjusted the copy must be entirely similar to the original; but the degree of contrast of the copy can be diminished or increased by enlarging or contracting the cross section of the luminous pencil, and consequently of the spot of light and the elements of which the resulting photograph is composed.

In most cases the receiver is of the same dimensions as the transmitter; but if the essential organs, namely, the screw, the cylinder, and the aperture of the receiver,

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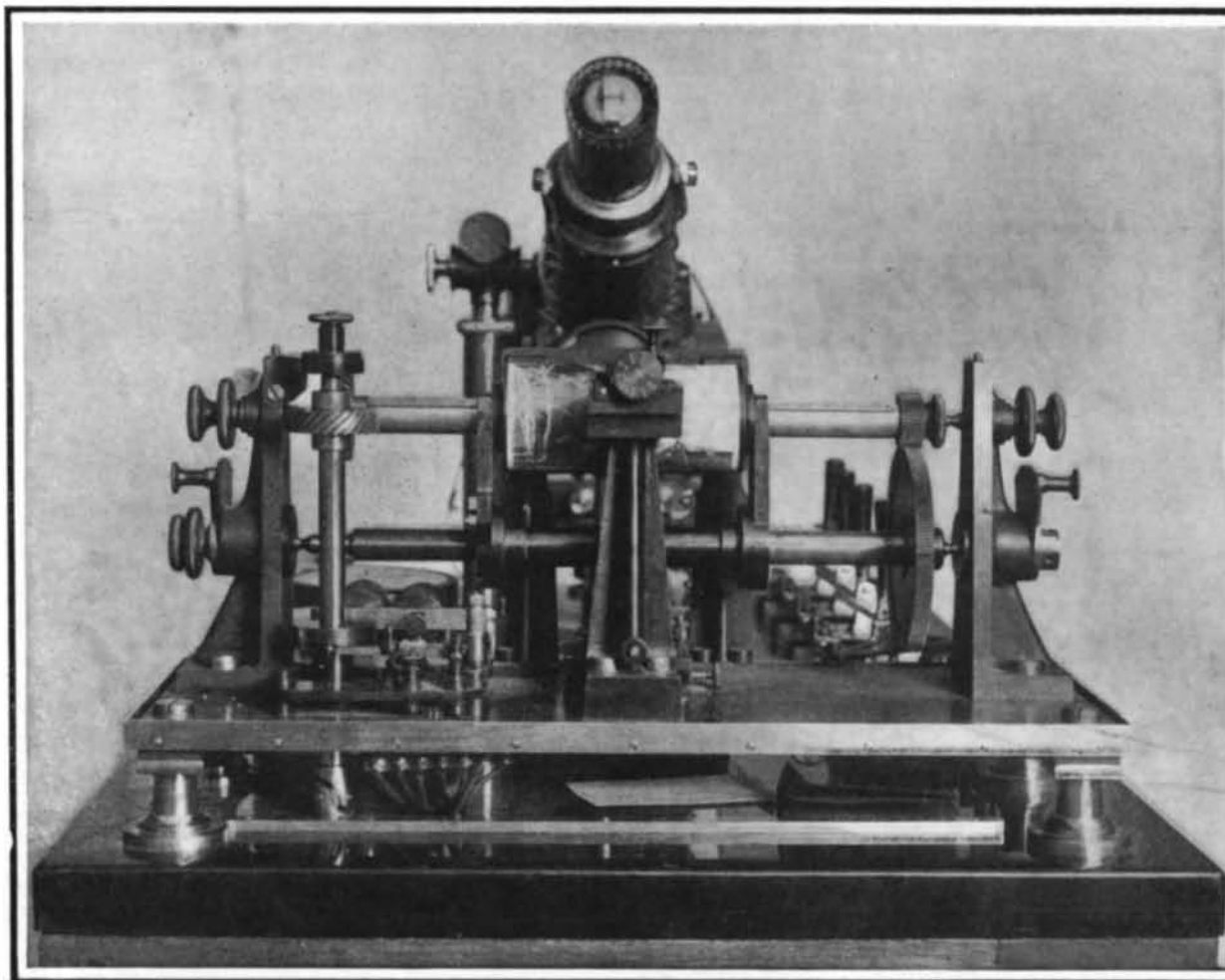


Fig. 3.—Front view of the apparatus with the cover of the cylinder removed.



Fig. 2.—The new Belin telestereograph.

BELIN'S IMPROVED APPARATUS FOR THE ELECTRICAL TRANSMISSION OF PICTURES.

pression, as some of the pressure would radiate off in other directions, and thus lack conspicuous expression.

Now, the tetrahedral hypothesis proposes to explain some, if not all, of these large facts. It is assumed that a more or less solid crust was formed, the earth being still, perhaps, in an approximately spheroidal form. If the interior goes on contracting, the external shell will be too large. But it is possible that it be maintained at the same size and with a smaller content if arranged in a form different from the spheroidal. One of the best of the forms permitting the same shell with a diminished interior is the regular tetrahedron. Perhaps this was not assumed at once, as at first the contraction would not be sufficient to demand a form having a fixed surface with a minimum interior. And perhaps the facts do not demand a consummation as yet.

Assuming that there is existent a well-advanced tendency of the lithosphere—not including the water—to take this form, we shall be able to explain some of the facts.

For the oceans would lie one on each face, with their depths in the center. They would be four in number. This would seem to agree with the requirements, if we postulate the Arctic Ocean as covering the region of the North Pole. If these did not fill their basins, the portions of the tetrahedron protruding would form the continents, each continent consisting of a corner with portions running off along the three edges meeting there. If the amount of water forming the hydrosphere were sufficient to cause each ocean to overflow the three sides of its containing triangle, but not enough to cover the corners, then we should have them all connected with each other, and each somewhat triangular in shape. The continents would be four in number and triangular in shape, Fig. 3. These would correspond to (1) North and South America, (2) Euro-Africa, (3) Asia-Australia, (4) Antarctica. To this it may be objected that North and South America constitute, not one triangle, but two. Likewise with Nos. 2 and 3. In reply to this, it may be suggested that we are not to assume that the tetrahedral tendency has reached completion. There may be at present more than four faces.

It will be observed that, since in a regular tetrahedron a corner lies opposite to a face, the continents are antipodal to the oceans, Fig. 2.

It is, perhaps, time for us to state distinctly just where on our present earth we may conceive the various corners to lie. First, we place one corner in coincidence with the South Pole. We thus account for Antarctica and the Arctic Ocean opposite. The three remaining corners we arrange thus: one on the Labrador peninsula, another in Scandinavia, and the third in Manchuria. They are thus not far from 120 deg. separated from each other. There are geologic reasons for this disposition. The rocks of these regions are of the most primitive character and of great extent, seemingly fitted to become the foundations of great land areas.

Now, it might be thought that if this hypothesis of a tetrahedral earth be true, we should find some evidence of a ridge running from corner to corner. By examining a map of North America, it will be found that there is such a ridge extending from east to west in the neighborhood of 50 deg. N. latitude, the rivers on each side flowing in different directions. In Asia extending across from east to west is a divide sending the rivers to the north of it to the Arctic Ocean. It may be that the Telegraphic Plateau in the North Atlantic is to be regarded as evidence of such a ridge connecting Scandinavia and Labrador.

As to the ridges extending from the northern corners toward the South Pole, the three double continents themselves supply evidence. Now, it might reasonably be thought that the divergence of the three ridges from each of the northern corners would give rise to a confusion of river flow. And the facts are in fair agreement with this. Also, it might just as reasonably be supposed that farther south—since the ridges are separate and extend north and south—there would be water flow to east and west. In South America this is the case. Likewise, Africa corresponds well to this requirement. Australia exhibits, perhaps, no very clear evidence.

Consider now the triangle formed by the three northern corners and their connecting ridges. With certain exceptions to be mentioned later, the principal mountain ranges in the north are parallel to these ridges. Thus, in Asia we have the Himalayas extending roughly from east to west. In Europe the same may be said of the Carpathians, the Alps, and the Pyrenees. The Ural Mountains, the Rockies, and the Appalachians are apparent exceptions. But these are said to belong to a different era of mountain formation.

There is another line of evidence which may be thought to have some bearing. This is in reference to polar flattening of the earth. This flattening was suspected because in 1672 a clock which was known to be a correct time-keeper in Paris was observed to lag two minutes per day in French Guiana. If a terrestrial radius in the latter locality were longer than

one at Paris, this loss might be accounted for, since in the one case the strength of gravity would be feeble than in the other, thus causing the clock to run more slowly. By actually measuring a degree of latitude in a far northern country and again near the equator, certain French astronomers were able to show, from the fact that the former was longer, that the earth was flattened at the North Pole. By carrying out the same process at the Cape of Good Hope, it was shown that there was flattening at the South Pole also. Now, these facts can be explained—and adequately, perhaps—by the oblateness induced by rotation when the earth was in liquid and plastic stages. But it has been shown that the southern flattening is not so great as the northern. Here is where the tetrahedral hypothesis enters with its Arctic depression and Antarctic elevation.

Now, it is quite possible, perhaps, that this hypothesis can not be made—in its present form—to explain everything, and can even be made to appear inconsistent with facts. But that would not necessarily mean that it is not a step in the right direction, containing a germ of real truth. Perhaps it may need modification. However, until the logic of inescapable facts intervenes, this may be looked on as a tenable and possible, though perhaps not complete, explanation.

#### BELIN'S IMPROVED APPARATUS FOR THE ELECTRICAL TRANSMISSION OF PICTURES.

(Concluded from page 440.)

are made  $n$  times larger or smaller than the corresponding parts of the transmitter, the copy will be correspondingly enlarged or reduced, but it will always remain as sharp as the original because the aperture is in contact with the film.

It was necessary to make some other additions to the primitive apparatus in order to allow the operators to exchange signals. For this purpose a system of bell signals is employed, operated by the synchronizing relay and a switch which connects the line either with a call or with the photographic apparatus, like the switch moved by the hook of the telephone.

In the recent experiments between Paris and Lyons the sender called up the receiving station by a prolonged ringing and the receiving operator replied with three short rings, and then waited until the sending operator had started his apparatus. The movement of the apparatus was indicated at the receiving station by a series of rings, the frequency of which increased with the speed of the motor, and gave to the operator an idea of the speed to be employed, while his commutator enabled him to obtain perfect synchronism. Then the photograph was transmitted in the manner above described.

M. Belin sent a portrait from Lyons to Paris in 5 minutes and 20 seconds, and a landscape photograph was then sent from Paris to Lyons in 9 minutes and 15 seconds. At the end of each transmission the circuit was broken and both operators were informed of this fact by the return to zero of the needles of their amperemeters.

It is not, however, necessary for the operator to observe the needle, as the motor simply goes on and when the cylinders have arrived at the end of their course they continue to rotate without advancing.

Lightning arresters and fusible plugs are added to each station.

M. Belin expects soon to repeat his experiment between Paris and London, Vienna and Rome. The object of the tele-stereograph is to reproduce not only photographs and half-tone pictures, but also all designs in black and white, including writing, printing, engraving, and process engraving. For this purpose the apparatus can be simplified.

At the transmitting station the lever, the wheel, the rheostat, and the resistance coils are omitted. Their place is taken by a simple and quick acting interrupter. The apparatus becomes, in fact, a Morse key worked automatically. At the receiver the graded screen is replaced by a narrow slit in a diaphragm placed before the lens. The transmitter is so arranged as to close the circuit when the tracing point enters the depressions, and to break it when the point passes over the raised lines. In this method, which is necessary for line drawings, the result is independent of the height of the relief. At the receiving station the luminous pencil may be arranged to fall upon the slit when the current is closed and to move away from it when the circuit is broken, or by a simple adjustment of the oscillograph, the rays may be thrown upon the slit when the circuit is broken and away from it when the circuit is closed. In the former case the lines of the original picture are represented in the copy by white lines on a black background; in the latter case they appear as black lines on a white ground. Either method may be used according to the object in view and also according to the direction of rotation of the cylinder, by which the direction of the lines may be reversed.

It is evident that when the apparatus is thus used for transmitting writing and line drawings by simply opening and closing the circuit, its operation is entirely

analogous to that of an ordinary telegraph. It may, if desired, be operated by a relay and even by wireless impulses.

As various systems derived from the inventions of Caselli and Meyer have recently been proposed, it is proper to insist upon the fact that Belin's method is entirely new and original. It is not necessary to execute the drawing or writing with insulating ink or with metal foil. A special, rapidly-drying ink may be used on any paper which can be easily stretched over the transmitting cylinder. Hence the new apparatus is a universal telegraphic instrument, since it transmits equally well writing, drawings, and photographs.

#### Official Meteorological Summary, New York, N. Y., May, 1909.

Atmospheric pressure: Highest, 30.26; lowest, 29.63; mean, 29.93. Temperature: Highest, 83; date, 14th; lowest, 40; date, 2nd; mean of warmest day, 74; date, 15th; coolest day, 46; date, 2nd; mean of maximum for the month, 68.0; mean of minimum, 52.8; absolute mean, 60.4; normal, 59.8; excess compared with mean of 39 years, 0.6. Warmest mean temperature, of May, 65 in 1880; coldest mean, 54 in 1882. Absolute maximum and minimum of May for 39 years, 95, and 34. Average daily excess since January 1, 2.2. Precipitation: 1.72; greatest in 24 hours, 1.22; date, 21st and 22nd; average of May for 39 years, 3.29. Accumulated excess since January 1, 0.23. Greatest precipitation, 9.10, in 1908; least, 0.33, in 1903. Wind: Prevailing direction, northeast; total movement, 9,169 miles; average hourly velocity, 12.3; maximum velocity, 48 miles per hour. Weather: Clear days, 7; partly cloudy, 11; cloudy, 13; on which 0.01 inch or more of precipitation occurred, 11. Thunderstorms: 1st, 6th, 14th, 28th. Dense fog: 1st, 9th. Mean temperature of the spring, 49.40; normal, 48.73. Total precipitation of the spring, 10.84; normal, 10.69.

#### Ozonizing a City's Water Supply.

The water supplied to Nice (105,000 inhabitants) and several smaller French cities is now purified by ozone, in addition to filtration. The following method has been adopted by the city of Chartres (24,000 inhabitants). The water is pumped from the river Eure into sedimentation basins which are contained in a building of ferro-concrete, with a double roof which keeps the water fairly cool in summer and prevents it from freezing in winter. The building has windows of yellow glass, yellow light being unfavorable to the development of bacteria. In these basins about 1,600,000 gallons of water are clarified in 24 hours. The water flows thence through coarse coke filters and fine sand filters to the ozonizing apparatus. The coke filter beds are cleaned, when they become choked, by exposing them to the air and washing away the oxidized impurities with a current of water. The sand filters are cleaned by powerful jets of compressed air and water, directed upward.

The ozonizing plant is constructed in duplicate, so that one section is always ready for use. The water trickles down through four beds of pebbles which have an aggregate thickness of 14 feet and are supported by perforated floors in a tower, at the bottom of which ozonized air enters under pressure. The ozone generator is a cell of glass 6 feet long, 3 feet wide and 6 feet high. It contains five elements, each composed of three cast iron plates. The middle plate is connected with a transformer which furnishes an alternating current of 20,000 volts; the outside plates are connected to earth. Between the iron plates are glass plates covered with tinfoil. Ozone is produced by the alternating electric discharges between the plates. The outer iron plates are perforated to allow the ozone to escape, and the middle plate is cooled by a current of water from a tank insulated by triple bells of porcelain. Air is forced into the generator under a pressure sufficient to carry it, laden with ozone, through the water tower. One grain of ozone is used for  $8\frac{1}{2}$  gallons of water. The primary circuit of the transformer is connected with an alternator which produces a monophasic current of 250 volts and 500 cycles. It is of interest to note that the price charged for water, about one cent for 44 gallons, has not been increased since the installation of the ozonizing plant.

#### British Patent Law Opposed.

The Lord Chief Justice, Baron Alverstone, delivered an address on May 28th before the section of the International Chemistry Congress which is dealing with legislation affecting chemical industry. He spoke strongly against the revoking clause of the new British patent law, saying he considered it a backward step which would result in people keeping their inventions secret. The scientists present were unmistakably hostile to the British patent law, and a resolution was unanimously adopted recommending that committees of the various countries adhering to international conventions agitate in favor of a general understanding providing that manufacture in one country belonging to the union protects the patentee against the revocation of his patent in other countries of the union.