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Television, or The Projection of Pictures Over a Wire

By H. Winfield Secor

PROBABLY there is no more interesting, and as yet unperfected, branch of science than that of *Television*, or the process of transmitting and reproducing a scene or a person's likeness over a wire, such as a telephone circuit, so that, for instance, a person telephoning over a line can see on a screen in front of him the person to whom he is talking.

There have been many attempts made to solve this fascinating problem. Several view before the instrument. Simply explained, this system works as follows:

Each selenium cell on the transmitter would be connected up with its individual lamp (very small, of course), and thus it is perceived how, at the receiving station a picture or view could be reproduced in black and white and intermediate tones, for the reason that each selenium cell would allow a different amount of current to reach its individual lamp.

can convince yourself of this by inspecting our illustration with a good lens. This brings out the logic of the argument previously referred to, viz., that it is possible, theoretically and practically, to make a machine that will reproduce a picture by such an arrangement of dots or points; whether all of the dots necessary in building up the picture are simultaneously thrown on the screen of the Television apparatus, or whether these dots are successively or very

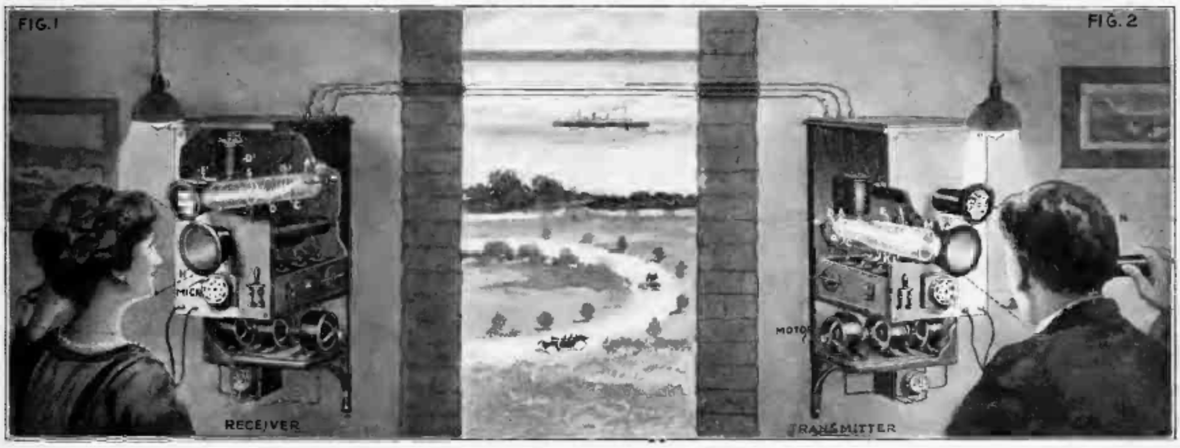

Fig. 1, at Left, Shows Image of Man at Right Being Transmitted and Reproduced on Screen in Front of Lady. Her Face is Transmitted and Reproduced at Fig. 2 (Right) Before Man. Mr. A. A. Campbell-Swinton's Scheme.

European scientists, including the late E. Ruhmer, of Berlin, succeeded in constructing such an arrangement for the simultaneous transmission and reproduction of living pictures over a wire by utilizing a great number of selenium cells, mounted very compactly in a small flat area.

Selenium, as we know, changes its electrical resistance proportionately to the amount of light thrown on same. Therefore, as every picture is made up of light and dark shadows, it is evident that if such a picture is properly projected on a group of selenium cells that the different cells will change their electrical resistance proportionately to the amount of light projected on them and corresponding conjointly to the light and dark shadows of the

This may seem a little ambiguous or complicated to those not familiar with the subject, but what we are driving at may be the more readily perceived or understood by inspecting Fig. 3A. The portrait photographed, reproduced by the half-tone process, exhibited at Fig. 3A, is photographed onto the copper plate used in printing the reproduction on this page, through a finely ruled glass screen. This screen therefore causes the original photograph to be broken up into many small dots. The illustration here referred to, for instance, has about 140 dots to the inch. By looking in an ordinary manner at the photograph here reproduced, no distortion is noticeable, and the picture appears quite natural. Nevertheless, *it is made up entirely of dots*. You

rapidly thrown on the screen, one after the other.

The second view, at Fig. 3B, shows a largely magnified portion of the (marked) eye on the face of the half-tone cut. This shows how the reproduction of the face is made up of small dots, and by closely looking at any newspaper illustration, which is usually photographed through a coarse screen, this *dot make-up* of the picture will be very evident. Some illustrations in magazines and books, which are reproduced on highly polished and specially coated paper, are photographed through such a fine screen that the keenest eye cannot perceive any break-up or dot formation.

As aforementioned, a number of work-

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ers have endeavored to solve this problem of "seeing over a wire," as it is commonly referred to, and one of the best methods tried in a laboratory, on a crude scale, is that of making use of a large number of selenium cells.

However, there are several drawbacks to this solution of the problem, some of them being enumerated below.

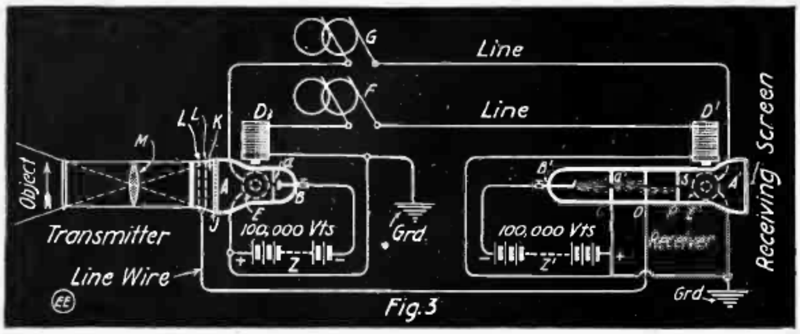

Fig. 3. Diagram of Proposed "Television" Scheme.

Selenium cells manifest a quality known as "time lag" in their electrical operation or action, and this means that it is difficult to build any such apparatus, as we now have under consideration, to act in an anywhere near perfect manner, when the selenium cells will show varying degrees of "time lag," or, in other words, when they tend to be sluggish in their action of changing from high to low resistance, etc. This lag is small, of course, and it must be understood that in considering the basis of this whole process that with the dot formation, even though made up of a vast number of small lamps, compactly grouped at the receiver end of the line, that the changes in the lamps' intensity, which is of course primarily dependent upon the action of the selenium cells on the transmitter, must be quite rapid, and this may be more readily understood when it is known that in the ordinary motion picture, with which we are all familiar, there

Fig. 3A. This Picture Is Made of Many Small Dots, Although You Wouldn't Think so. Note Marked Eye in Fig. 3B.

are from 16 to 20 different pictures projected on the screen per second. This has been found to give us a fairly steady picture owing to the "lag" of the human eye in perceiving an object in motion. That is to say, the eye does not loose its impression simultaneously, but the object's impression on the retina of the eye remains for a fraction of a second, and this explains how motion pictures are made possible by the present methods in vogue.

It has been estimated by a well-known English authority and scientist, who has worked along the line of Television, that if the selenium cell process was to be used to give good close-grained results on a surface only two inches square, there would be required 150,000 wires, 150,000 selenium cells, 150,000 lamps. While even to obtain an effect no better than that used in the coarsest process blocks, as used by ordinary daily newspapers, there would be required at least one-tenth that number of selenium cells, lamps and wires.

Working on this basis, but reducing the number of cells, etc., to be used, to a figure of 90,000, this scientist calculated that the cost for a 100-mile transmission circuit, including apparatus at both ends, would amount to the staggering sum of $6,250,-000. This considers simply a monochrome reproduction in black and white only of the view or object over the circuit. If the apparatus in question should have to be triplicated, so as to give a colored picture, by the well-known three-color process, then the cost would naturally rise to three times the amount stated.

From this figure it is to be seen that evidently such a solution of the problem is far beyond us and not capable of industrial or practical applications, in the strict sense of the word.

Some workers in this field have also devised or advocated at different times very clever and ingenious methods, which seem quite good theoretically, for using a less number of selenium cells, lamps, etc., but to gain the same effect as if a large number of cells were used, by suitably moving a beam of light over the various cells successively at very high speed, and some similar arrangement being used at the *lamp* end of the circuit, where the picture is to be reproduced. This would act upon the principle of the retina retention of impression, as previously mentioned, and such ideas are based upon the theory that with proper apparatus, which unhappily is nearly impossible to construct from a mechanical standpoint, that each cell could be used for a fraction of a second.

One of the latest and most promising (theoretical) systems of Television—the *Telephot*—or the instrument for "seeing over a wire," makes use of a stream of cathode rays, which can be deflected and changed in their direction of production very rapidly, and moreover, these rays possess an infinitesimal amount of momentum or mass. This method has been brought forth by an Englishman, Mr. A. A. Campbell-Swinton, president of the Röentgen Ray Society, of London.

The apparatus based on his descriptions and ideas are shown in the illustration at Figs. 1 and 2. In this picture detailed apparatus only is shown for transmitting pictures one way, or, in this case, from right to left; the detailed receiving apparatus being then at the left of the picture and the transmitting apparatus with high frequency A. C. generators, etc., being shown at the right. Both transmitting and receiving tube openings are shown, however. It is evident that one can easily, and without any awkward motions, glance slightly upward to view the reproduced face in the smaller upper screen, which is shown placed at a small angle. A dictagraph or super-sensitive telephone transmitter is probably best for such instruments and is observed under the *television screens.* Six wires are required to transmit pictures both ways.

We may now briefly consider the operation of this apparatus advocated by Mr. Campbell-Swinton, and which has been favorably received by the scientific world, *although as yet not practically demonstrated.* The schematic diagram, Fig. 3, will help the reader to understand the diagnosis of its operation. Three line wires are necessary between the apparatus, as observed from the illustrations at Figs. 1 and 3. At the *transmitter* end of the line there is used a focusing lens barrel "X." The object whose reproduction is to be electrically transmitted over the line is arranged at the tube opening, as at "N." A Crooke's vacuum tube is used at "A" and at "B" is the cathode electrode of the tube, from which the cathode rays are shot forth at an incredible velocity and which have

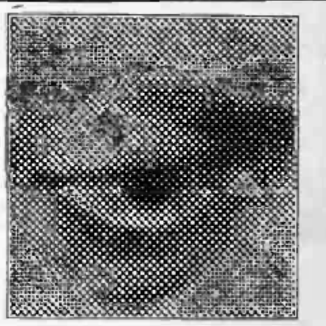

Fig. 3B. Hold This 18 Inches From You and the Effect Will Be Seen to Give the Facial Features Noted Inside the Marked Square on the Face at Fig. 3A.

practically no mass or momentum. An anode "C" of circular form is placed in the tube, which has at its center a small aperture or opening "a." Through this opening a small stream of cathode rays may pass; these rays being produced by a high potential *continuous current* from a source "Z," giving in the neighborhood of, say, 100,000 volts. Placed at right angles about the tube "A" are two electro-magnets "D" and "E," and these are energized by alternating currents from the A. C. generators or dynamos "G" and "F." These magnets allow of readily controlling or deflecting the cathode rays stream in a vertical and horizontal direction, respectively.

At "J" in the transmitter tube is placed a special screen, the whole surface of which is searched out by the stream of cathode rays, every tenth of a second, under the combined action of the A. C. electro-magnets "D" and "E." It should be mentioned here that the dynamos "G" and "F" produce *widely different* frequencies of alternating current; one of them producing, say, 1,000 complete positive and negative alternations per second, and the other 10 such complete alternations per second. The special screen "J" is proposed to be a gas-

(*Continued on page* 172.)

is obvious, for it must not be forgotten that we look upon the top of the towns—the roofs—and the general color of these does not differ essentially from the streets and the surrounding grounds. For that reason the cities cannot be seen. If all the roofs and the streets were painted in white I am sure that the large towns could be seen, given a clear atmosphere. Thus, you observe, the earth as seen from the moon appears quite lifeless. Nothing is seen moving on it except the clouds; only in one instance have I seen anything out of the ordinary. This was a large forest fire in western America. Even then I could, of course, not see the fire itself, but only the vast, rolling quantities of black smoke were easily discernible. Other objects which can be made out when the weather is very clear on earth are the rivers; but only the larger ones, such as the Mississippi, the Amazon, the Nile, the Volga, etc., can be seen at all. We repeatedly tried to see long railroad tracks stretching across plains, but we have not been successful in locating them, even by the use of our powerful 3-inch telescope. The intervening distance—240,000 miles—is simply too great to see such fine objects. For this reason also some of the greatest achievements of man, such as the Panama and Suez canals, are entirely invisible to us, even with the assistance of our telescope

From the above it must become clear that comparatively small objects such as ships, trains, animals, etc., must forever remain invisible to us *Lunarians*.*

So much for the earth. As I mentioned before the stars appear much brighter on the moon than they do on earth. This again is due to the very thin lunar atmosphere. All the stars appear several times brighter to us than they do to you; furthermore, we can see with our naked eye stars such as are never seen on earth except with the aid of powerful telescopes.

The most inspiring view, however, is the milky way. It shines with a glory undreamed of on earth; its light is so powerful that objects around you become faintly visible in the dead black of our lunar night. The milky way does not appear to be as a weak blur, but it is well defined and we see myriads of stars invisible to the unaided eyes on earth.

There is one thing, however, of importance on the moon of which few people have any conception. I am referring to the meteors which are constantly raining on the surface of the moon. When such a meteor falls on the earth this is what happens:-

A great mass of meteoric iron has come under the influence of the earth's attraction and is falling toward it at a speed of several thousand miles a minute. Until it reaches the outskirts of the earth it meets with no resistance, for it moves in the vacuum of universal space. The instant it penetrates the earth's atmosphere an enormous friction is produced between the meteor and the air, and the result is that the meteor becomes wholly or partly melted. Most of it volatilizes and goes up in smoke, to fall down subquently in the form of fine dust; only a comparatively small solid part reaches the earth, where it usually buries itself in the ground. Thus when we see a "shooting star" we see in reality a stream of fire produced by the melting of a meteor.

Now, the moon with its pitiful atmosphere affords no such protection as does the earth's atmosphere. Meteors crash about us with an alarming frequency. They come without any warning whatsoever. Some are as large as a watermelon and some as big as a small house. You can hardly imagine what happens when such a heavenly projectile, moving at the frightful speed of from 2,000 *to* 3,000 *miles a minute*, collides with the moon.

The noise of the impact is absolutely overwhelming. The crash of a cannon shot of a 15-inch gun is soft hand-clapping in comparison with it. The ground trembles violently for miles around, and if you are less than 500 yards from the scene one will usually be blown off his feet by the concussion, notwithstanding the very thin lunar air. If the meteor happens to strike a rocky or granite surface the result is even more awe inspiring. As a rule, in that case the whole meteor melts in an instant and goes up in a cloud of white-hot metal vapor. If you are near enough, say within one-half mile, the heat generated by the impact will become unsupportable for a short length of time, and within a few minutes exceedingly fine metallic dust will rain down upon you. It sometimes takes hours for this reddish dust to settle down.

Thus it can be imagined that it is rather dangerous to walk on the moon's surface. This is particularly true in November each year, when the earth and the moon pass through the meteoric "streams." At such a time I would not care to be present on the surface of the moon, and would prefer the lunar caves. Furthermore, I . . ."

Münchhausen did not finish his sentence. There was an abrupt, sharp click in my phones and the ether was ominously quiet once more. For some time I tried frantically to "raise" him, but in vain; he did not reply to me. I became highly alarmed about his safety. Had one of the meteors struck him and killed him? I could not tell. So I finally left my wireless laboratory with an uneasy feeling that everything was not quite right.

(*To be continued.*)

*Term applied to inhabitants of the moon.

TELEVISION OR THE PROJECTION OF PICTURES OVER A WIRE.

(*Continued from page* 132.)

tight structure, made up of a very large number of extremely small metallic cubes, which are all carefully insulated from one another, but, however, presenting a smooth, clean (metallic) surface to the cathode ray discharge on the one side and in contact with a suitable gas, as, for instance, sodium vapor, on the other. It is proposed to construct these screen "cubes" of some metal, like rubidium, which readily discharges negative electricity under the action of a ray of light, the negative charge being imparted to the cubes whenever the thin, pencil-like beam of the cathodic ray falls upon it. The receptacle "K" in the tube chamber is filled with some gas, such as sodium vapor, for the reason that such a gas conducts negative electricity far more readily under the influence of light than in the dark. A metallic screen of gauze, parallel to "J" in the tube is placed at "LL," and through this screen the image of the object at "N" is projected by means of the condensing lens "M," until after passing through the vapor of sodium it is eventually focused on the screen "J." The gauze screen "LL" is electrically connected through a line wire, as seen in Fig. 3, to the metallic diaphragm plate "O" in the receiver tube "A1."

Referring now to the receiving instrument, as indicated in our illustrations at Figs. 1 and 3, there is placed at the end of the Crooke's vacuum tube a fluorescent screen "H," and upon this screen, under certain conditions, which will be explained directly, the cathodic rays impinge, and certain parts of this screen are searched out every tenth of a second by the thin ray, under the combined action of the two A. C.

electro-magnets "D'" and "E'," which are placed similarly to the A. C. electro-magnets "D" and "E" at the transmitter station. As will be observed, the magnet coils "D" and "D'" are energized by the same A. C. dynamo "F" and also the A. C. magnet coils "E" and "E'" are excited by the alternator "G." It is therefore evident that the two magnetic-control circuits "D" and "D'" and "E" and "E'" and their resultants are therefore in perfect synchronism, i. e., their actions take place at the same time.

A Crooke's vacuum tube "A'" is used also at the receiving station as indicated, and its cathode electrode appears at "B'." The disk of this electrode, which shoots forth the cathodic ray, is slightly inclined so as to project the ray at a downward angle, through the small opening "a'" in the anode electrode disk "C." Thus, under normal conditions, the cathode rays pass through opening "a'," but they would be stopped by the diaphragm "P" and its centrally located orifice "S." They, in this case, are not brought under the deflecting action of the A. C. electro-magnets "D'" and "E'" and thus do not reach the image screen "H" before the observer at all. At "O" is a metallic circular disk, which is electrically connected with the screens "LL" at the *transmitter* instrument. Under ordinary conditions the cathode rays at the receiver cannot pass beyond the diaphragm "PS," but they can be made to do so, if slightly repelled by the lower diaphragm plate at "O." In this case, they will then fall on the screen "H" and cause *that part* on which they fall *to fluoresce* (i.e., light up).

Now assume that a uniform beam of cathode rays passes at marvelous velocity and without any appreciable inertia or mass in the tubes "A" and "A'" and that also the A. C. electro-magnets "D" and "E," "D'" and "E'" are energized, as previously explained. Also, suppose that the image of a person, for instance, appears at "N" before the tube "X"; this image is focused and projected through the lens "M," and through the gauze screen "LL" on to the back of the metallic screen "J," which, as will be remembered, is made up of a very large number of small metallic cubes. Then as the cathode rays in "A" oscillate under the combined action of the A. C. electro-magnets "D" and "E" they will cause a negative charge of electricity to be imparted in turn to all the metallic cubes, of which the screen "J" is composed. In the case of the shadows of the projected image, or considering those cubes on the screen on which no light falls, nothing will happen in the action of the apparatus, the charge dissipating itself in the tube. Therefore, in the case of those cubes on the screen which are brightly illuminated by the bright parts of the projected image, the negative electrical charge imparted to those cubes by the cathode rays will pass along, owing to the action of the sodium vapor, which is ionized under such circumstances, and so on until it reaches the gauze screen "LL," whence the charge will travel by the line wire to electrode "O" in the tube "A'" at the receiving instrument.

The plate at "O" will therefore become charged and will slightly repel the rays in the tube, with a result that they will thus be enabled to pass through the aperture at "S" and strike, for a fraction of a second, upon a minute portion of the screen, corresponding in position to the small cube surface on screen "J." This is possible, owing to the fact that the electro-magnets "D'" and "E'" are working in perfect synchonism or step, electrically, with the magnet coils "D" and "E" at the transmitter.

It will be understood, of course, from this description that this action will take place successively, but *not* simultaneously. In other words, referring back to our previous discussion of how a picture can be built up out of black dots, etc., it is easily perceivable how this device could produce a picture if the illuminated spots on the screen are successively shown in a sufficiently rapid manner. In the case of our little metallic cube surfaces at "J," that are illuminated successively, there appear bright spots at simultaneous periods on screen "H" at the receiving instrument. These bright spots at "H" are of course to appear so quickly, and succeed one another so rapidly and smoothly, that the appearance they present to the eye will be one continuous picture.

It is quite conceivable that the apparatus of the future, which will enable us to see the party at the opposite end of a telephone line, for instance, may indeed work on this principle or a modified one. There is no other method which can work so rapidly and with so little inertia as this one utilizing the Crooke's tube, in which a cathode ray is caused to rapidly oscillate or be deflected through various angles in the same way as the Braun oscillograph tube is used for depicting radio-frequency wave forms. It was the Braun vacuum tube oscillograph that suggested the idea to Mr. Campbell-Swinton for this really ingenious *proposed method of perfecting a Television apparatus.* This is undoubtedly one of the most interesting fields for research work open to the experimenter of to-day.

NAVY TAKES OVER SAYVILLE RADIO

In the interests of American neutrality and to avoid contravention of the Hague Convention forbidding the establishment of belligerent wireless stations on neutral soil during a war, the United States Government refused to grant a license to the Atlantic Communication Company for the operation of the great German wireless station at Sayville, L. I., and took over the operation, management and control on July 9 last.

The Atlantic Communication Company claims to have committed no improper or unneutral act. Further it says: "No charge of any such act has been brought to the attention of its officers by any official of the United States. The Government censors on duty at the station have carefully supervised all messages sent, and have retained copies of the same. The company, being a public service corporation, had no discretion in refusing or accepting messages. As a matter of fact, the station, on account of static conditions, and also on account of lack of power, was unable during the summer months to communicate with Germany for more than one or two hours during the night. This difficulty will now be overcome by the operation of the new transmitter. Communication has been possible for the past few months only when it was night in Germany and night in the United States, which has been, as heretofore stated, only for one or two hours each night."

"And I want to add," Mr. Metz, president of the company, continued, "that as a result of the Federal action to-day we will be able to communicate with Berlin all the time, day and night, instead of an hour or two each day, as has been the case up to the present time. We will now for the first time be able to use the new plant, which is three times more powerful than the old plant, and that plant will be ready the 15th of this month. And, furthermore, there will be a reduction in rates. Instead of $1 a word plus the land rate the rate to Berlin will be 50 cents per word plus the land toll, while messages for Austria and Turkey will be 58 cents per word plus the land charges instead of $1.08 per word as is now the case.