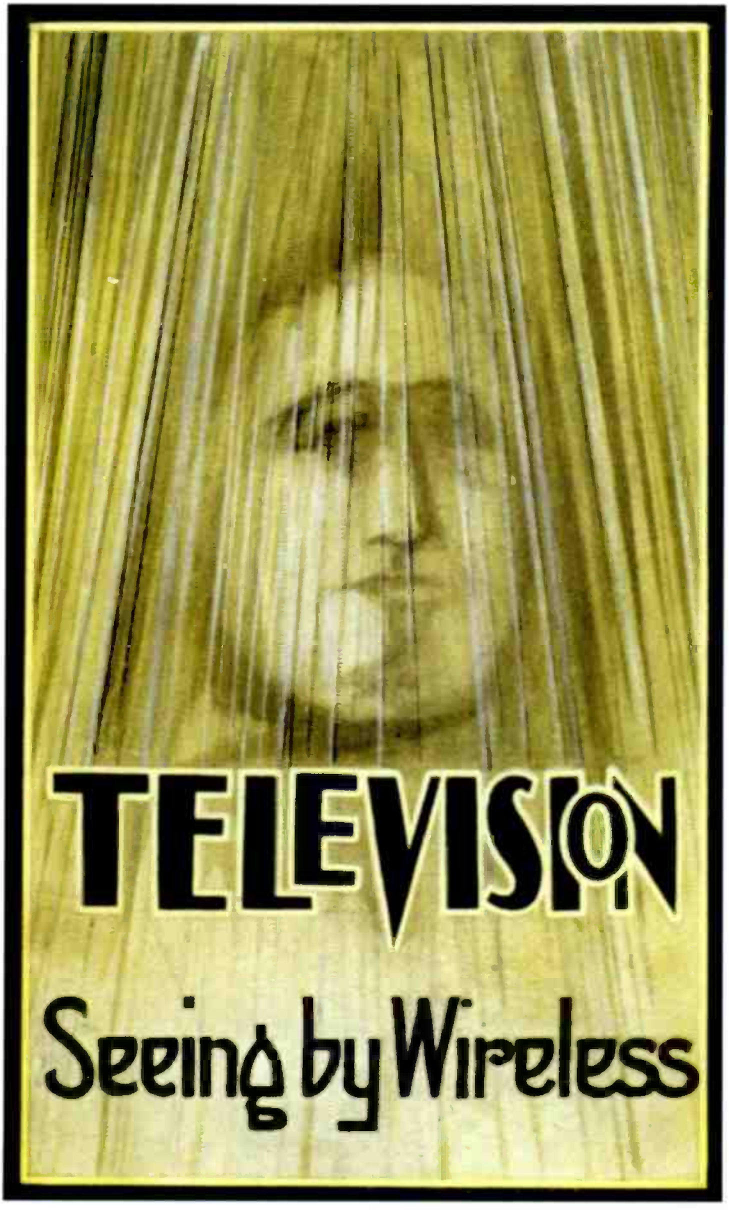
TELEVISION
Seeing by Wireless

TELEVISION

(Seeing by Wire or Wireless).

By

ALFRED DINSDALE, A.M.I.R.E.,

MEMBER, R.S.G.B.

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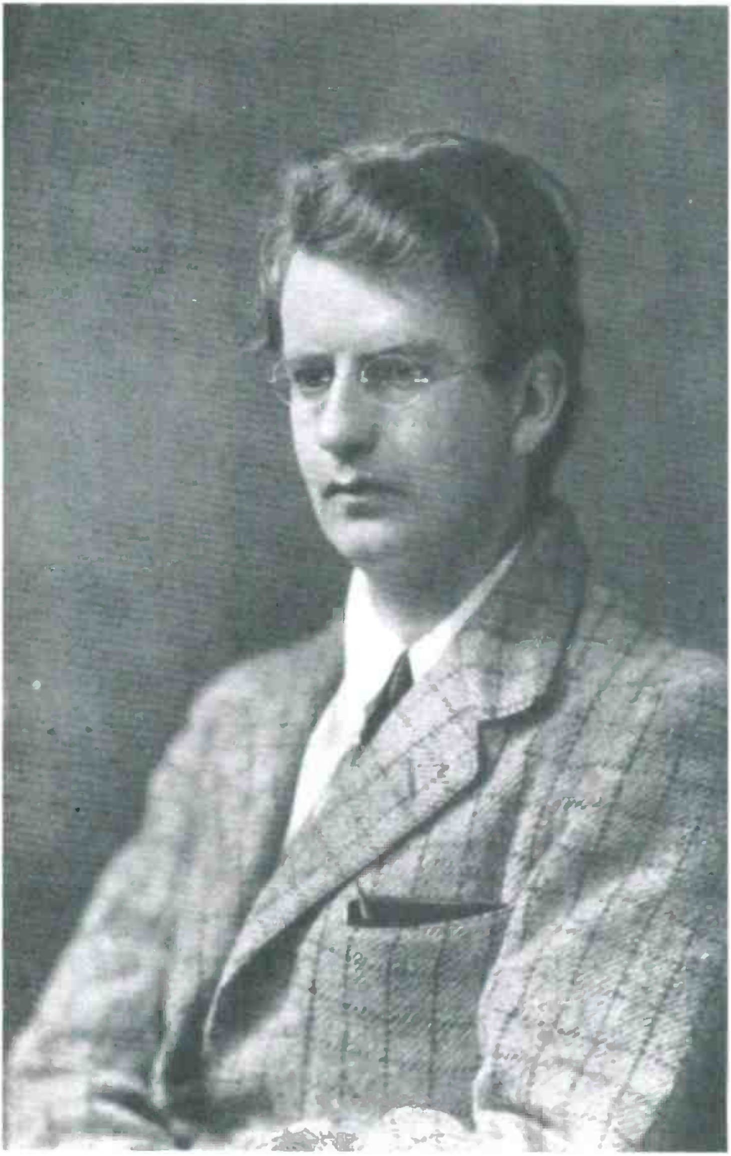

MR. JOHN L. BAIRD.

THE FIRST SCIENTIST IN THE WORLD TO DEMONSTRATE TELEVISION.

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CHAPTER I.

INTRODUCTION.

WE of the present generation are living in a most marvellous age, but how many of us pause for a moment to dwell upon this fact? It is to be feared that very few of us do, for, together with its host of scientific marvels, this age, like all others, has its concomitant disadvantages. All is rush and hurry, a scramble for a mere existence, which wears away our energies and occupies our time to the almost total exclusion of all else.

We have not time even to think. From the time we wake up in the morning till the time we retire again for the night, all our mental and physical energies are directed to the accomplishment of worldly tasks, in return for which we receive the wherewithal to live. On the way to business in the morning we do not walk and admire the beauties of nature on the way; we are projected there mechanically, the intervening period being taken up with the business of scanning the morning paper.

Throughout the day we handle, and are handled by, mechanical contrivances the mechanisms of which the vast majority of us do not understand. We have neither the will nor the time to understand them. In the evening we are transported home, again mechanially, and again we scan a newspaper to pass the time. Arrived home, we are, as a rule, too tired for anything but relaxation. In the summer it is a game of tennis perhaps. In the winter we sit by the fireside and read, but even this latter occupation requires a certain amount of mental effort which we frequently feel indisposed to make, and, perhaps, we listen to the radio instead.

Occasionally, in rare moments of introspection, we may take stock, as it were, of all the scientific marvels around us, and then, and only then, do we appreciate to the fullest extent the marvellous scientific achievements of the last fifty years.

To mention but the most outstanding of these modern inventions, consider the telephone, the gramophone, and the cinematograph, and, more recently, wireless telegraphy and telephony, the aeroplane and the airship.

No one but a Jules Verne could have visualised, a hundred years ago, that to-day we would be able, by means of a simple instrument to be found in every business office and a very large number of homes, to converse freely with friends and business connections across a continent.

No longer is a journey abroad an adventure fraught with great peril, and the duration of it a period of anxiety for those left behind. No news is good news, says the ancient proverb, but human nature is such that we prefer to have news just the same, and the absence of it causes untold worry and unhappiness.

To-day we travel speedily and luxuriously in gigantic liners, in perfect safety, surrounded by all the comforts to which we have become accustomed.

Much of the speed and safety of this form of travel is due to the perfection of a swift and sure means of communication—wireless telegraphy,—and by means of it also we can, day by day, keep in touch with the world's news and with our friends. No matter where we may be on the surface of any of the Seven Seas, wireless telegraphy is at our service, enabling us to exchange greetings with loved ones left behind.

Fifty years ago—nay, only thirty years ago—it was customary to refer to a highly imaginative achievement as being no more possible than flying in the air. To-day, flying in the air is an accomplished fact. The Atlantic has been spanned and the world girdled by this latest vehicle of travel. A war has been fought partly in the air. Regular air services now exist between London and Paris, and several other Continental capitals. Here again wireless telegraphy and telephony contribute to the speed and safety of the aircraft engaged upon these services.

Turning now to the social side of life, let us consider what changes have been wrought in the home. With the advent of electricity we have available unlimited power, clean and noiseless in its operation. It illuminates our homes for us and operates all sorts of machinery designed to make the lot of the housewife easier. On a winter's evening we can, through its contributive agency, turn on our broadcast receiver, and, from the comfort of our favourite armchair by the fireside, we can listen to an enormous variety of entertainment, ranging from opera to musical comedy, from symphonies to jazz, from serious lectures upon every topic under the sun to comedians. So perfect has this form of entertainment become that we have only to shut our eyes to imagine ourselves in the opera house or the concert hall, as the case may be, to derive the same amount of enjoyment from the programme that we would were we actually present at the original performance.

Should we tire of the radio, we have but to turn to the gramophone, chosing such records as will fit in with the mood of the moment. The entire gamut of musical entertainment is open to us to choose from, and the reproduction of the latest types of gramophone compares very favourably with the original performance. Again, all that is wanted is sight of the performers to make this form of entertainment equal to the original.

Tiring of the atmosphere of the home, we can go out to a cinematograph theatre and there witness drama and comedy staged in appropriate surroundings. From the comfort of an arm chair we can circumnavigate the globe and witness the strange scenes of the Orient, or the busy activity of some faraway city. We can experience the sensations of a voyage upon a rolling ship, or the thrills of looping the loop in an aeroplane. But the silver sheet is mute. We can see the actors speak, but no words are audible. Guns thunder forth their menace to an enemy or their welcome to a distinguished visitor, but we hear no sound. True, an orchestral accompaniment is provided, and, sometimes, the appropriate sound effects are simulated, but it is not the same thing.

However, even this disability of the cinema has now been overcome. By simultaneously photographing a scene and recording the accompanying sounds, both a visual and an aural appeal can be made to an audience. Simultaneously with the presentation of the picture the appropriate music, speech and sound effects are reproduced electrically, the two effects being ingeniously synchronised by electrical means, so that the resultant illusion of personal contact with the performers is well-nigh perfect.

This is indeed a great advance over previous methods of visual and aural entertainments. The combination of synchronised electrical sound reproduction with the cinema in this fashion supplies what is lacking to both the cinema and the gramophone. It makes it possible for us to enjoy simultaneously both the sights and sounds of distant places, musical entertainments, and so on. It has been said, and with reason, that no longer need the great artistry of our leading singers and instrumentalists be ephemeral. No longer need their superlative art die with them, nor the enjoyment of it be confined to a select few.

Even this latest advance suffers from a time-lag disadvantage. Both films and sound records have to be prepared some time in advance of their presentation to the public, and this disability is particularly pronounced in the case of news films. Although films can be made and produced nowadays with astonishing speed, there is always a delay of a few days, or, at best, several hours, between the actual events recorded and their presentation in the cinema theatre.

Year by year thousands of football enthusiasts travel from one end of the Kingdom to the other to witness for themselves the performance of their favourite team in the Cup Tie finals. There are many thousands more, however, whose circumstances do not permit them to indulge so freely in their favourite relaxation. For these, the cinema must suffice, and before they are able to see the teams in action on the silver sheet, several days must, in most cases, elapse, during which time they have read all the available newspaper descriptions of the match, and the news is somewhat stale. The news reels, too, only show short "shots" of the leading features of the game.

In America some advance on sport reporting has been made by sending out radio reporters to the scene of sporting events, equipped with microphones and pick-up wires, so that radio listeners may be treated to an up-to-the-minute word picture of the game. This is a further improvement, certainly, but here again there is something lacking. However vivid the word picture of the contest, the listener must draw upon his imagination to visualise exactly what is taking place on the field.

Will the day ever come when we may, by wireless, both see and hear simultaneously what is occurring at a distance, and that instantly as the occurrences take place?

A mad dream? Certainly not! *It has already been accomplished in the laboratory of a scientist, and over short distances outside of his laboratory, and this* new and startling scientific development is called

TELEVISION!

Throughout the history of scientific discoveries of an entirely novel and revolutionary character, it has been found that when new epoch-making inventions are announced, the announcement is usually received apathetically by the general public. This is, at first glance, strange, but on reflection it seems to be but natural. What can the Man in the Street be expected to know of the latest discovery and of its potential applications when even the inventor's fellow-scientists show such lack of imagination and appreciation that, all too often, they can see nothing useful in the new invention? Frequently the inventor is even scoffed at as a mountebank or an imposter, or, perhaps, just a fool.

When Graham Bell first discovered the telephone, his fellow-scientists dubbed it "an interesting toy," and let it go at that. No one but the famous inventor himself saw the usefulness of his great discovery, its enormous potentialities for service to mankind.

Such is the general lot of all pioneers. Too often their work is not appreciated at its full value until they have long since departed from this world. In the case of the more fortunate, even they have to contend with public apathy and scepticism, and, perhaps, opposition, before the general public finally acquires a sufficient knowledge of the latest invention and its possibilities to accept and make use of it. Unless this happens within the lifetime of an inventor, there is no profit in the business of inventing—at least, not for him.

In the succeeding chapters of this book, therefore, we propose to deal in detail, and in a popular manner, with the world's latest and most startling discovery

Television, following through the early attempts made by various investigators right up to the final attainment of the much-coveted goal by John L. Baird.

CHAPTER II.

What Television is. The Human Television System. The Selenium Cell. The Experiments of Rignoux and Fournier and Rhumer.

Television means literally vision at a distance. It is a composite word derived from the Greek tele—"at a distance," and the Latin verb video "I see." This mixing of Greek and Latin is repugnant to classical minds, and several letters have appeared recently in the press objecting to its use. These objections, however, have come too late, the word "television" is already part of the English language, and may be briefly defined as "vision by telegraphy."

With Television we see what is happening at a distance while it is happening.

For short distances, provided no other objects intervene, this is done daily with the naked eye, and for greater distances with a pair of binoculars or a telescope. But no eyesight, binoculars or telescope will enable you to see through brick walls, or from your armchair at home see the Prime Minister speaking in the House of Commons.

You could, of course, see a photograph afterwards of the Prime Minister speaking, and if the photo had been transmitted by wireless or land line telegraphy, instead of being sent through the post, this would be "photo-telegraphy." It is not television.

Novelists have had no doubt as to what television meant. In countless books you see the miracle of seeing what is actually happening elsewhere, treated as an achieved fact, and embodied into the story. Actually it is only very recently that the miracle has become a fact.

The history of television forms one of the romances of modern science. It may be said to date from the discovery of the light sensitive properties of selenium.

Before its light sensitive properties were known, selenium was used in telegraphy to provide the high resistances necessary, for selenium, unlike other metals, offers an enormous resistance to electricity.

It was this property which led to its use in the Atlantic cable receiving station at the village of Valentia on the west coast of Ireland.

It so happened that one afternoon sixty years ago, in 1873 to be precise, the operator, a Mr. May, noticed that the instruments were behaving in a strangely erratic fashion. The sun was shining through the window, and its light occasionally shone upon the selenium resistances used. Every time the light fell upon the selenium the needle of his instrument moved.

The light sensitive properties of selenium were thus discovered accidentally by an obscure telegraph operator.

This discovery created widespread interest. It opened up enormous possibilities by giving a means of turning light into electricity, and the scientists of those days were quick to predict that selenium would provide an electric eye to supplement the electric ear which the then recently-invented telephone had given to them.

There was, however, a serious difficulty to overcome, and over 50 years had to elapse before the solution was found. This was the difficulty, that whereas the natural eye sees the whole scene in one comprehensive glance, it was not possible for the selenium to achieve the same result.

Perhaps the simplest way to make the matter clear is to consider that very perfect Television apparatus, the human eye, with its connecting nervous system. The eye itself may be compared to a camera. It has a lens and a screen, the lens throwing an image of the scene before the eye upon the screen. This image has to be conveyed to the brain, and Nature's method of solving her Television problem has formed the basis of many of the first Television schemes. A clue to the solution of the problem is found in a close examination of the human screen, which is called the retina. The surface of this is found to consist of a mosaic made up of an enormous number of hexagonal cells, and each of these cells is directly connected to the brain by a number of nerve filaments, along which travel impulses which are dependent upon the intensity of the light falling on the hexagonal cell. Exactly how these impulses are generated is not at present fully understood, but they are almost certainly due to the presence of a light sensitive substance named visual purple which flows through the hexagonal cells. The images which we see are thus built up of an extremely fine mosaic of microscopic hexagons of varying degree of light and shade. The number of these hexagonal cells is stupendous. In a normal human eye there are several millions. The early experimentors endeavoured to construct artificial eyes by substituting selenium for visual purple and building an artificial retina out of a mosaic of selenium cells, each of these cells being connected by wires to a shutter. This shutter opened when light fell on the cell connected with it, and allowed a spot of light to fall on a screen. In this way each cell controlled a spot of light, the image being reproduced by a mosaic formed of these spots.

Models on these lines were actually made by several inventors. Rignoux and Fournier, two French scientists, constructed such a machine in 1906. This apparatus was intended only to demonstrate the principle, and had no pretensions towards being an instrument for Television. The transmitter consisted of a wall covered with selenium cells, 64 fairly large cells being used. From each of these cells two wires ran to the receiving screen, which was made up of 64 shutters, each shutter controlled from its respective cell, and thus when a strong current from a brilliantly lighted cell at the transmitter arrived at the receiving station the shutter was opened and light was allowed to fall on the corresponding part of the receiving screen. By covering the transmitting wall with large stencils, letters of the alphabet were transmitted and could be recognised.

Ernst Rhumer, also, whose brilliant pioneer work in connection with wireless telephony is so well known, constructed a similar apparatus, and many other workers have been attracted by this system, but the thousands of cells, shutters and wires necessary made the practical adaptation of such schemes out of the question, and an endeavour was made to solve the problem in quite a different manner.

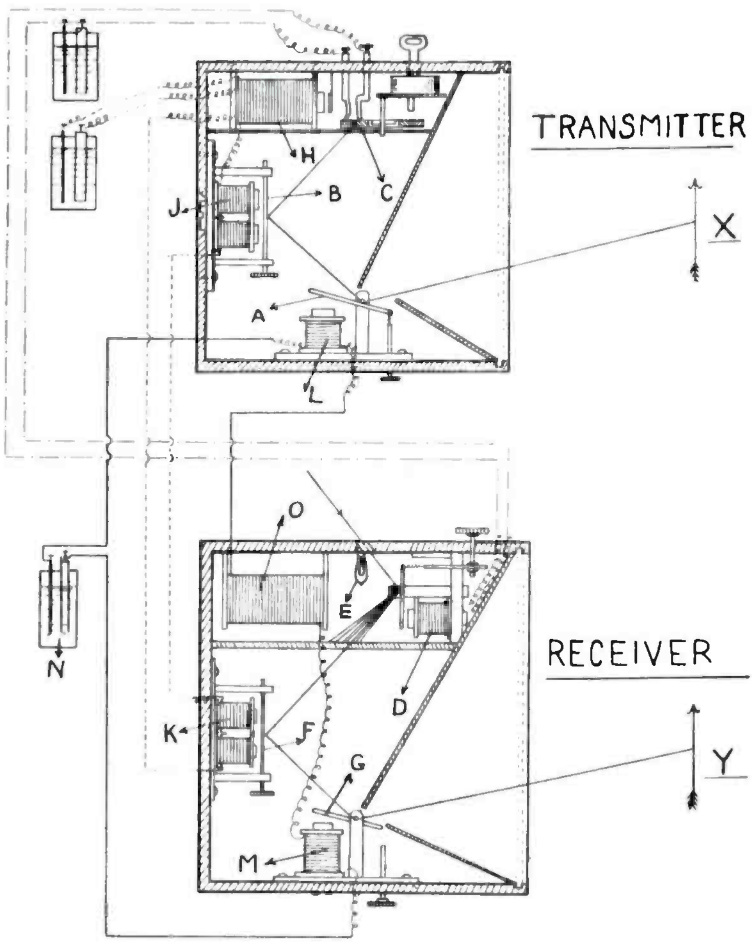
The suggested alternative was to divide the scene up into a great number of small parts and to transmit it section by section to the receiving end, and to achieve this so rapidly as to create the effect of an instantaneous glance.

Imagine, for example, that by means of a lens an image of the object or scene to be transmitted is thrown on a ground glass screen just as in a camera, imagine then this image divided up into thousands of little squares like a chess-board, each one of these little squares is dark or light, depending on what part of the picture it belongs to.

Now we have to send this picture along a wire or over the wireless. Assume there are one thousand squares numbered 1, 2, 3, 4, 5, 6, 7, etc., to one thousand, then if we send a series of messages: 1 dark, 2 light, 3 light, 2 dark, to our friend at the receiver, who has a board before him divided also into 1,000 squares, and he makes his squares dark or light as directed, he will build up the mosaic similar to the mosaic on our ground glass camera screen. Now, in this operation we looked at each little square and our eye told us whether it was dark or light.

If we passed a light sensitive cell over the squares it would send out an electric signal which would be weak or strong corresponding to the light or shade of the image, and if, instead of a friend we had a mechanical device directing a beam of light from a lamp on each square of the receiving board in turn at the same time as the cell at the transmitting station passed over the corresponding square on the ground glass screen, and if, further, the intensity of the light was controlled by the current from the cell, then each area of the board at the receiver would in turn be illuminated with a brightness corresponding to the brightness of the same square on the transmitting screen. If this progress is gone through eight times every second, then the observer would see on the receiving board not a moving light spot of varying intensity but the whole image at once, due to the phenomenon of retentivity of vision. This is roughly what happens in Television.

Upon this principle a great number of devices have been evolved, and it is to development along this line of research that success was ultimately due.



SZCZEPANIK'S TELEVISION APPARATUS

FIG. I.

X = Object to be transmitted. A = First vibrating mirror. B = Second vibrating mirror. C = Selenium cell. D = Magnet controlling light spot E = Source of light. F = Vibrating mirror. G = Vibrating mirror. H = Synchronising coil supplying alternating current to J & K. J = Magnet controlling B. K = Magnet controlling F. L = Magnet controlling A. M = Magnet controlling G. O = Synchronising coil supplying alternating current to L & M. Y = Received image.

CHAPTER III.

Various Attempts to Solve the Problem: Szczepanik, Rosing, Mihaly.

In a short work of this kind it would be impossible to give anything in the nature of a complete account of the apparatus used by the early workers. These workers, however, although they were unable themselves to achieve results, laid foundations upon which later on the inventive genius of their successors was to build, and we can at least describe two of the most representative and suggestive of the many schemes put forward.

The first of these is due to Jan Van Szczepanik. His arrangement will be best understood by referring to the diagram shown on fig. 1: "X" the object to be transmitted is focussed firstly on to mirror "A," which vibrates in the direction shown by the arrows; from "A" it is reflected to the mirror "B," which vibrates at a much slower rate in a plane at right angles to "A"; the combined action of these two mirrors causes the image to traverse the aperture to the cell "C" in a zigzag path.

At the receiver the operation is exactly similar, but a spot of light controlled by the magnet "D" replaces the light sensitive cell. The intensity of this light depends upon the deflection of the armature, which is dependent on the current from the cell at the transmitter.

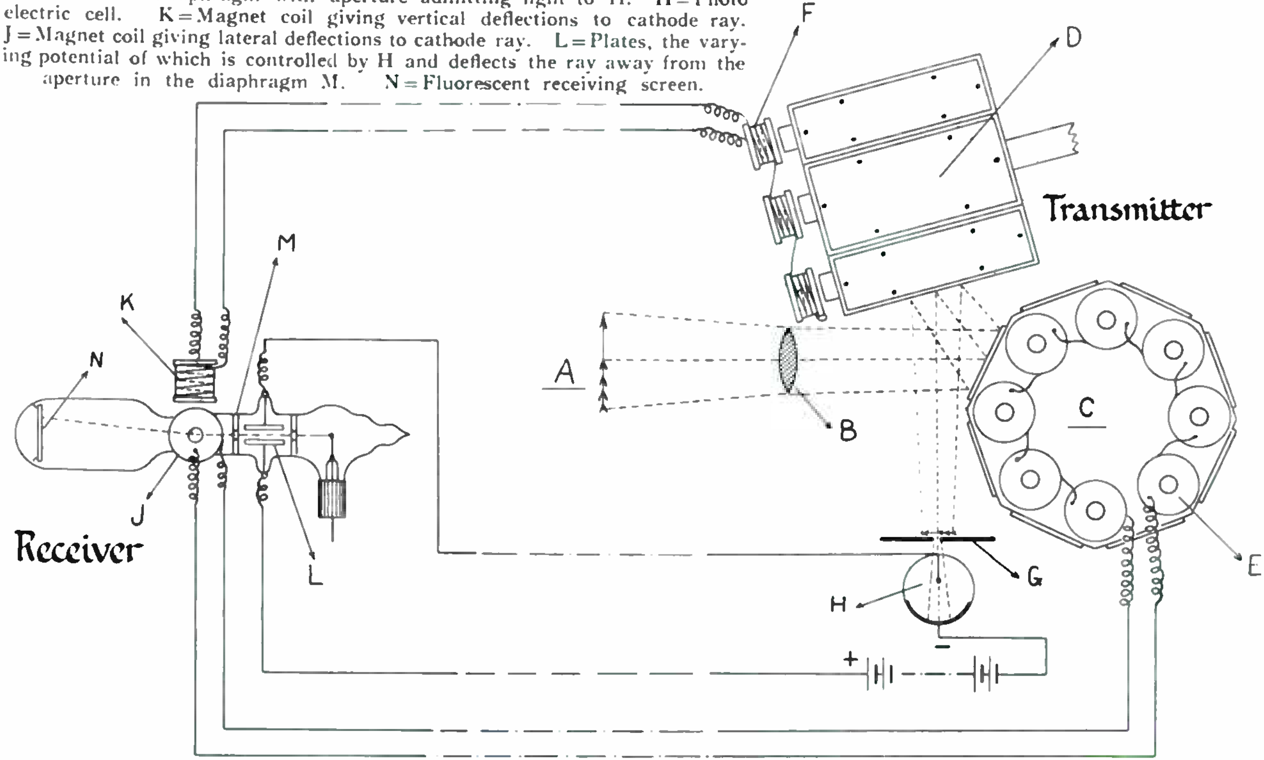
Another device of a more interesting character is that suggested in 1907 by Boris Rosing, a Russian Professor. His transmitting arrangement was similar in principle to others, but his receiving device was very original. He dispensed altogether with mechanical parts, and used instead the cathode ray. This ray is a form of electrical discharge which occurs when electricity is forced through a high vacuum. The rays can be produced in the form of a thin pencil-like discharge, and this pencil of rays can be moved in any direction either magnetically or electrically; it has no weight and therefore no inertia, and there is thus no limit to the speed at which it can travel. When this ray strikes a plate of fluorescent material a brilliant spot of light is produced, so that by using the cathode ray in conjunction with a fluorescent screen we can get a receiving device capable of following almost any speed.

Rosing used as his transmitter two mirror polyhedrons revolving at right angles to each other, their combined motion causing an image of the object to be transmitted to pass over a light sensitive cell. The varying current from this cell was transmitted to the receiver. Here it electrified two condenser plates, which deflected the cathode ray away from an aperture placed in its path, the amount of the ray which passed through being proportionate to the potential of the plates.

This ray was caused to traverse a fluorescent screen by currents transmitted from coils mechanically connected to the mirror polyhedrons.

A = Object to be transmitted. B = Lens. C = Mirror polyhedron with magnets attached. D = Ditto. E = Stationery coils generating alternating current. F = Ditto. G = Diaphragm with aperture admitting light to H. H = Photo electric cell. K = Magnet coil giving vertical deflections to cathode ray. J = Magnet coil giving lateral deflections to cathode ray. L = Plates, the varying potential of which is controlled by H and deflects the ray away from the aperture in the diaphragm M. N = Fluorescent receiving screen.

FIG. 2.



ROSING'S TELEVISION APPARATUS

In more recent years Denoys Von Mihaly, in Vienna, constructed an apparatus, using very small mirrors mounted on twin wires vibrating in a powerful magnetic field to explore the image. The mirrors were extremely small and light, so that the moving parts had little inertia. The system was very complex, and as in other systems the Selenium Cell was used. The time lag of the cell and the extreme complexity of the apparatus prevented practical results from being achieved.

CHAPTER IV.

The Photo Electric Cell.

It will be interesting to consider the barriers which have prevented these many schemes from achieving success. The vast amount of research work done in this field can only be appreciated by those who have studied the subject, and it seems at first sight strange that a problem which on paper appears comparatively simple should have proved so infinitely baffling in practice.

The great difficulty may be summed up simply. It is in the light sensitive cell. Selenium, upon which the early investigators based their hopes, has what is known as "time lag" or "chemical inertia"—it does not respond quickly enough. To achieve Television thousands of signals must be sent out in a fraction of a second, and this the selenium cell simply proved unable to do.

Thus although the optical part of the problem was solved by many of the early workers, the light sensitive device proved an insuperable barrier.

The development of what is known as the photo electric cell appeared to offer a way out of the difficulty. The photo electric effect was discovered by Hertz in 1888. He found that when ultra violet light fell upon a spark gap the electric discharge passed more readily. This effect was investigated by another German Scientist named Hallwach, who found that the effect was located at the negative pole, and, farther, that it was very much more pronounced with certain metals, notably Rhubidium Potassium and Sodium.

By using this effect a new form of light-sensitive device was obtained as an alternative to selenium. This device, which consisted essentially of a plate of Rhubidium, or potassium, and a collecting wire or plate enclosed in a vacuum tube is quite instantaneous in its action. It has no "time lag" like selenium.

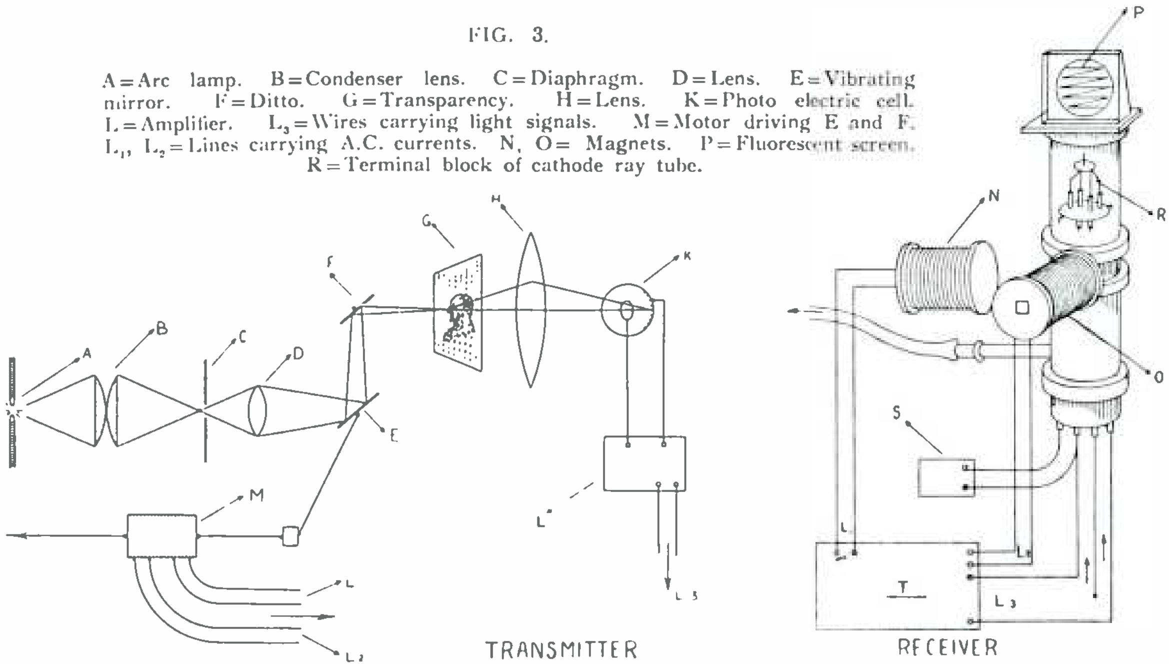
As soon as this new device became available, attempts were at once made to use it for Television in place of the sluggish selenium. Again however, disappointment was in store. The photo electric cell proved to be insufficiently sensitive. It would not respond sufficiently to the infinitesimally small light quantities available in Television.

Some idea of the enormous sensitivity demanded will be obtained when it is realised that the whole light reflected from such an object as the human face illuminated by lamps of a thousand candle power, is less than that of a single candle, and, further, that in Television only an infinitesimal fraction of this already very small light is available.

Using the photo electric cell, however, it is possible to send shadows, for here the light difficulty does not arise; any intensity of light desired may be used as the lamp shines directly into the cell. That is to say, the cell has to distinguish between total darkness and a light which may be almost as intense as we like to make it.

FIG. 3.

A = Arc lamp. B = Condenser lens. C = Diaphragm. D = Lens. E = Vibrating mirror. F = Ditto. G = Transparency. H = Lens. K = Photo electric cell. L = Amplifier. L_3 = Wires carrying light signals. M = Motor driving E and F. L_1, L_2 = Lines carrying A.C. currents. N, O = Magnets. P = Fluorescent screen. R = Terminal block of cathode ray tube.



MM BELIN AND HOLWECK'S TELEVISION APPARATUS

CHAPTER V.

The present state of the Art. The Experiments of M.M. Belin and Holweck and Messrs. Jenkins and Moore.

In recent times the problem of Television has been taken up seriously by Mr. Baird in this country, by Messrs. Jenkins and Moore in America, and by M.M. Belin and Holweck in France. It is proposed to devote this chapter to an account of the work done abroad.

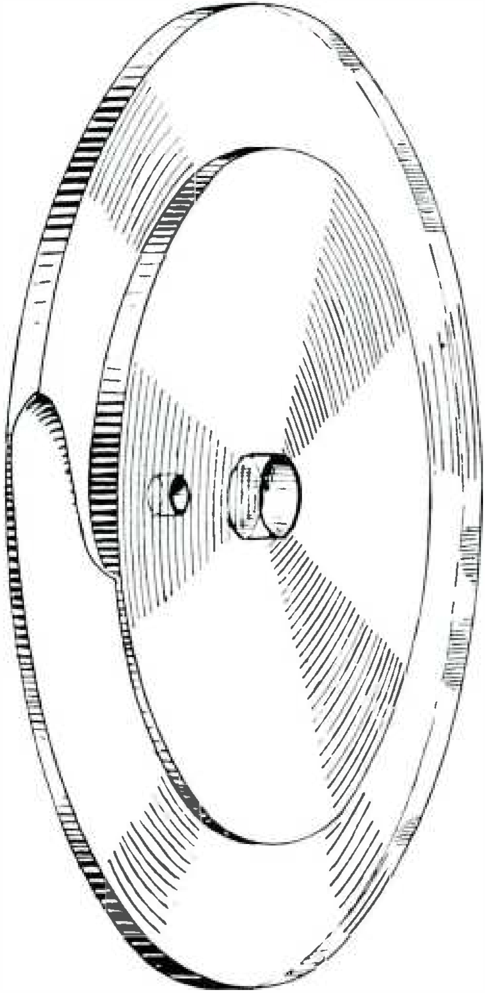
The next chapter will be devoted to the work of Mr. Baird, to whom the solution of the Television problem is due.

M. Belin, whose name is known in connection with Photo Telegraphy, has, in conjunction with M. Holweck of the Radium Institute, it is stated, succeeded recently in sending shadows of simple objects. The transmitter of Belin and Holweck consists of two mirrors vibrating at right angles to each other; these mirrors cause the image to traverse a Potassium photo electric cell. The current from this cell controls the intensity of a cathode ray at the receiver, the ray being caused to traverse a fluorescent screen by magnets which are energised from an alternating current transmitted from a motor which moves the mirrors at the transmitter.

The arrangement used will be best understood by reference to the diagram Fig. 4.

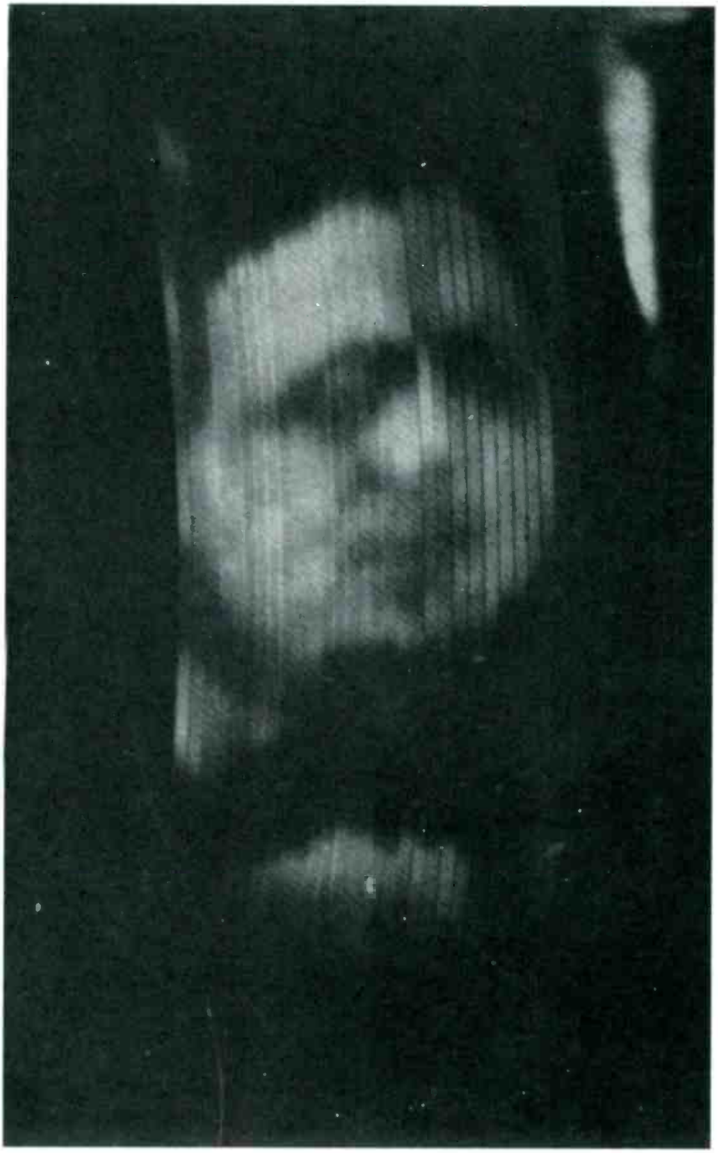
In the United States Mr. C. F Jenkins, who, like M. Belin, is known in connection with Photo Telegraphy, has also, working in collaboration with Mr. MacTaggart Moore, succeeded in sending shadows. To cause the image to traverse the cell they use a Prismatic disc. This consists of a circular glass disc, the edge of which is ground into a prismatic section, the section varying continuously round the circumference. Light passing through this disc is therefore bent backwards and forwards as the section changes, and by passing the image through revolving discs of this nature it is made to traverse a Photo electric cell. The current from this cell is transmitted to the receiving station, where it controls the light from a lamp invented by Mr. Moore. This lamp changes its intensity instantaneously in proportion to the current, and its varying light is caused to traverse a screen by a similar device to that at the transmitter.

The drawing Fig. 5 shows the form of prismatic disc used by Messrs. Jenkins and Moore.



JENKINS PRISMATIC DISC

FIG. 4.



The first photograph ever taken by Television in the world's history. This is an untouched print of a photograph of the image which appeared on the screen of the first Televisor.

CHAPTER VI.

THE BAIRD "TELEVISOR." THE PROBLEM SOLVED. TRUE TELEVISION DEMONSTRATED AT LAST.

We have in the preceding chapter given a summary of the work of the scientists in other countries in pursuit of a solution to the Television problem, and we now turn to the work done in our own country.

The inventive genius of Graham Bell, a Scotsman, nearly 50 years ago, gave to the world the Telephone, and now J. L. Baird, another Scotsman, has demonstrated Television, giving us with his "Televisor" an electric eye to add to the electric ear given us by Bell.

The history of how this coveted distinction was at last achieved forms one of the many romances of science, for science has its romances, and among the test tubes and coils of the laboratory the research worker explores an untrodden land vaster and more fraught with possibilities than ever lay before the boldest Buccaneer. The new world of science has not one but a limitless number of El Dorados: its riches are inexhaustible and its extent infinite.

In the field of scientific research it is comforting to know that much of the best work has been done by individuals working alone without the aid of vast organised laboratories and armies of skilled assistants, and Television is no exception.

Mr. Baird is a "son of the Manse," his father being a Presbyterian Minister. He was trained as an engineer, and on the outbreak of war was studying at Glasgow University. He offered himself for enlistment, and being rejected for active service, served throughout the war as a superintendent with an Electrical Power Co.

On the conclusion of hostilities he started in business with a patent sock which he had invented. This sock took the form of a sheath of special material worn under the ordinary sock. It proved very popular and business brisk. Money rolled in, and Baird looked like making a fortune, then health intervened in the form of a complete physical and nervous breakdown, and all business had to be abandoned.

We will not trace his subsequent activities. sufficient to say that they form an amazing record of enterprise and ability dogged by continual ill health and recurrent illness.

Through the years of an active business life, Baird had one hobby—scientific research. In the early days of his training he had endeavoured to produce an improved selenium cell, and had devised a system of Television, so that when in 1923 he finally found himself compelled through ill health to abandon business and lead the life of a recluse, he again took up the threads of the Television problem where he had left them so many years previously.

With unlimited time at his disposal it was not long before a measure of success was obtained, and when after a few months work shadowgraphs were success-

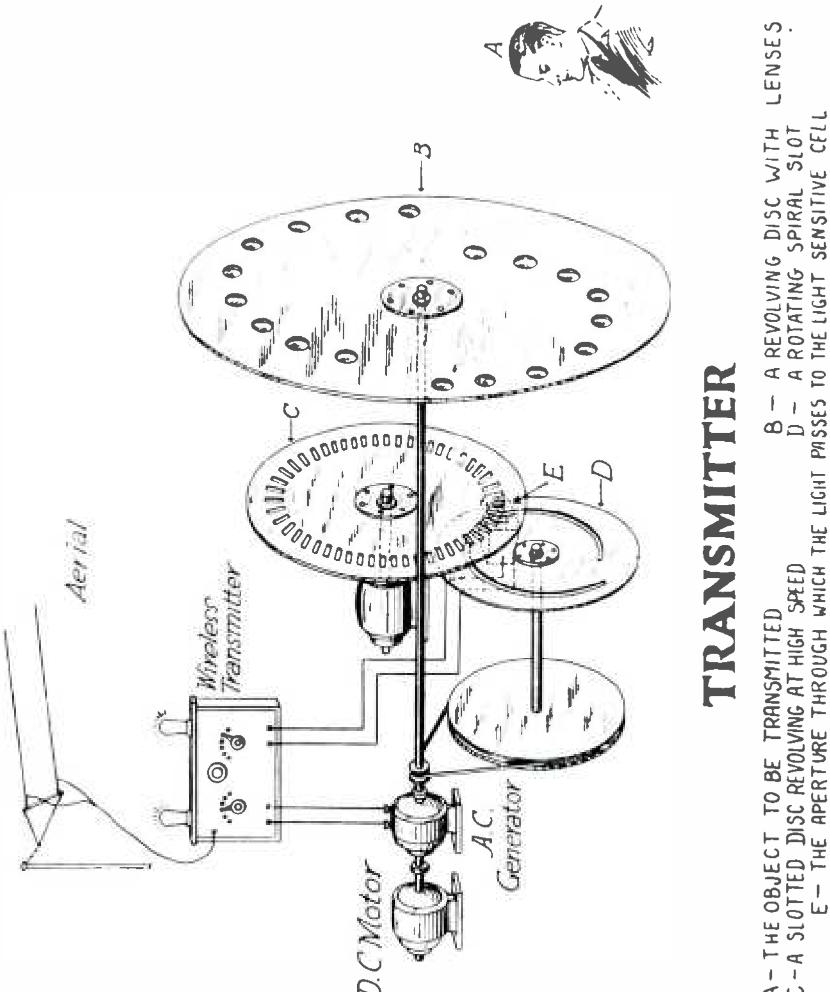
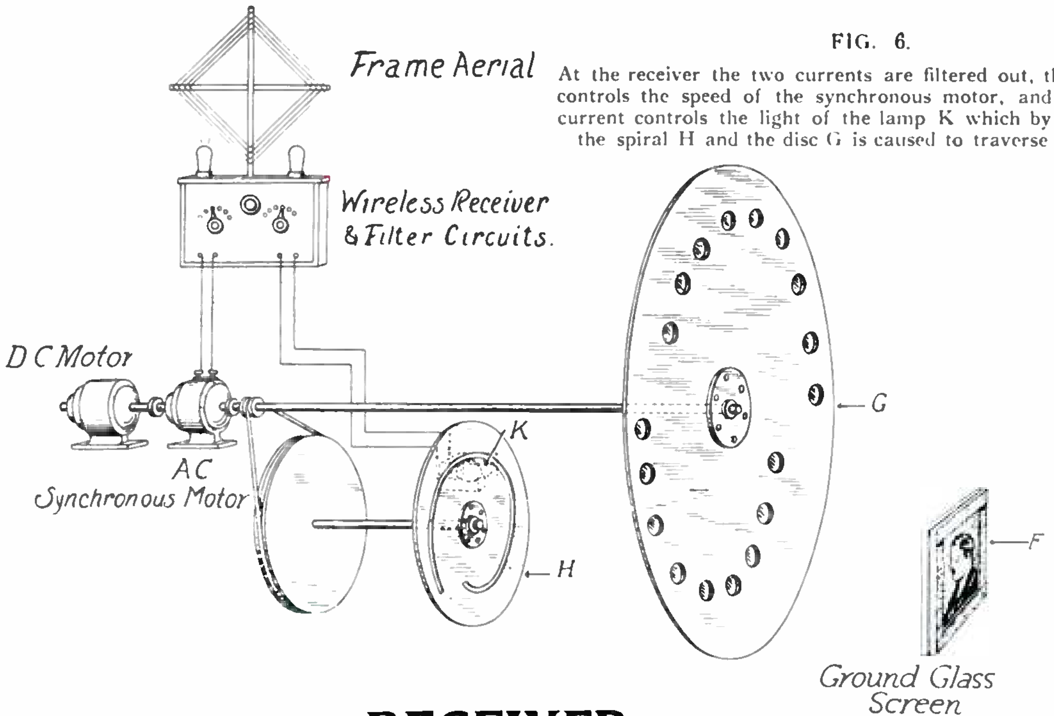


FIG. 5.

The disc B rotates at about 800 r.p.m., and causes a series of images of A to pass across E; before reaching E the light is broken up by the slots in C, which revolves at 4,000 r.p.m.; the light must also pass through D, the rotation of which has the effect of giving E a back and forward motion and so divides the image into a greater number of strips, *i.e.*, it is equivalent to using more lenses in B. The fluctuating current from the cell and the A.C. current from the generator are superimposed on a carrier wave and transmitted to the receiver.

FIG. 6.

At the receiver the two currents are filtered out, the A.C. current controls the speed of the synchronous motor, and the fluctuating current controls the light of the lamp K which by the rotation of the spiral H and the disc G is caused to traverse the screen F.



RECEIVER

F — REPRODUCED IMAGE

G — REVOLVING DISC WITH LENSES

H — ROTATING SPIRAL SLOT

K — THE APERTURE, THROUGH WHICH THE LIGHT PASSES FROM THE VARYING LIGHT SOURCE

fully transmitted, hope ran high, but, like subsequent investigators, he soon found that to transmit shadows was one thing, to transmit the images of the objects themselves a very different thing.

Month after month he worked with apparatus of the very crudest description. He used the biscuit tins, sealing wax, and string beloved of the true research worker, and scoffed at by the sterile pedant.

In April of 1925 he had, however, the satisfaction of giving the first public demonstration of Television, transmitting outlines by wireless between two separate machines at a famous Oxford Street Store.

It will be understood from the foregoing chapters that the accomplishment of Television hinged upon the production of a light sensitive device of enormous rapidity of action and very great sensitivity to light. The exact nature of Mr. Baird's light sensitive device has not been made public, but we can give the reader some account of the mechanism used in the earlier experiments.

The original machine with which Mr. Baird first achieved the transmission of outlines by reflected light is now in South Kensington Science Museum, and its mode of operation will be understood best by reference to the diagrams. The object to be transmitted was exposed to the light of a 1,000 candle-power lamp, an ordinary metal filament projection lamp being used.

By means of a revolving disc carrying 16 lenses in staggered formation, images of this object were caused to pass over a second revolving serrated disc.

This had the effect of breaking up the light of the image into a series of flashes. Behind this serrated disc revolved at a slow speed a third disc, in which was cut a spiral slot which passed in front of a longitudinal slot admitting light to the light sensitive cell. The combined action of these discs was to cause the whole of the image to fall on the cell in a succession of little areas of varying brilliance.

The current from the light sensitive cell varied in accordance to the brilliance of the flashes, and the varying current was transmitted to the receiving machine, by wire or by wireless.

At the receiving machine an optical system similar to and revolving exactly in step with the transmitting machine was used, the light sensitive cell being replaced by a glow discharge lamp, the varying light from which was projected on to a ground glass screen, this varying light spot being dark at the shadows and bright at the high lights and traversing the screen with such rapidity, that retentivity of vision caused the whole image to appear instantaneously.

Synchronism, that is the keeping in step of the transmitter and receiver was obtained by means of an alternating current generator directly coupled to the shaft of the transmitter. The alternating current from this modulated a carrier wave, and was received at the receiver as a note of the frequency of the generator. This note, after amplification, controlled the speed of a synchronous motor coupled directly to the shaft of the receiving machine, and thus both machines were kept in exact step.

A Ventriloquist Entertainment by Mr. Arthur Prince, being Televised at 2 T.V.

The outlines transmitted were not shadows, but were transmitted by reflected light—a most important point, showing an enormous advance over shadowgraphs. They were, however, very rough and flickering, and mere outlines.

The demonstration created considerable attention, but Baird's weird apparatus—old bicycle sprockets, biscuit tins, cardboard discs and bullseye lenses, all tied together with sealing wax and string—failed to impress those who were accustomed to the shining brass and exquisite mechanism of the instrument maker. The importance of the demonstration was, however, realised by the scientific world, and many of the leading scientists and engineers came to inspect the apparatus.

The general opinion held was that, while these results showed a remarkable advance, and were not to be ignored, true Television—the transmission of the living scene with light and shade and detail—was still a long way off.

Ten to fifty years was variously estimated as the time required before it would be possible to see and recognise a person by Television.

Baird was not discouraged. In the obscurity of his attic laboratory he worked on—money was becoming scarce; results had to be achieved—and achieved they were!

On January 27th, 1926, a strange gathering thronged the stairs leading to the little attic laboratory in Frith Street. Baird had at last achieved Television, and without reckoning on the seating accommodation necessary, he had invited the Royal Institution to his laboratory to see a demonstration. Over forty members turned up, and the laboratory was only capable of holding five or six at a time! However, by exhibiting to them in relays, all were in turn given a demonstration. Living moving human faces were transmitted between two rooms by Television.

Not as outlines, not as mere black and white effects, but with gradations of light and shade and detail—it was true Television at last! As one of the members said: "He has got it. Development is now purely a matter of L.S.D."

With Television a demonstrable reality, financial support was easy to obtain, and Baird's troubles were at an end. A Television Broadcasting Station is now nightly giving experimental broadcasts, and there can be little doubt but that what is now a scientific marvel will, in a few years, be as commonplace as the wireless broadcasting of sound is to-day.

NOTE.—Those interested will find full accounts of demonstrations in "The Electrician," June 28th, 1926, and "Nature," July 3rd, 1926.

Erecting the Aerial at 2 T.V., the world's first Television Broadcasting Station.

CHAPTER VII.

2. T.V. the World's First Television Broadcasting Station. Development of Television a One-Man Job.

Since the demonstration described was given to the members of the Royal Institution, vast strides have been made, and the results to-day are much more perfect. Having secured a licence from the Postmaster-General, Mr. Baird is now experimenting with the broadcasting of Television by wireless, and for this purpose he has built upon the roof of the offices of Television Limited, in the heart of London, the world's first Television Broadcasting Station.

The receiving station used in connection with these experiments is situated at Harrow, nine miles away, and experimental transmissions are being made nightly, after broadcasting hours, on a wave-length of 200 metres. These broadcast pictures are from real life. That is to say, human beings are seated before the transmitter and Televised to Harrow over the ether. At Harrow these persons are received, or rather seen, upon the screen of the receiving televisor.

A remarkable thing about these transmissions is that the objects placed before the transmitter send out an ether wave according to their shape. If the transmissions are listened to on an ordinary radio receiver, it is possible, with a little training, to tell what it is that is being televised. For example, the face of an individual looking straight at the transmitter sends out a series of sounds something like "Brump, brump, brúmp," but when turned sideways the profile gives out a note like "Perahh, perahh, perahh." A hand with fingers extended, if passed in front of the transmitter, sounds like the grating of a very coarse file, and an inanimate object, such as a box, gives a single steady note. This the animate object cannot do, for the slightest movement of the features is turned into sound waves by the transmitter.

In order to combine the broadcasting of ordinary speech and music with the broadcasting of Television, using the same transmitting station, it is, of course, necessary to make the Television impúlses inaudible. This is done by raising the frequency, or pitch, of the Television impulses above the audible level, and by the use of electrical filters, or separating apparatus, to divide off the speech and music impulses from the Television impulses.

Thus, when Televisors become available to the public it will only be necessary to instal one to enable us all to *see* what is occurring in the broadcasting studio, just as we now *hear* what is taking place there. We will then receive vision as well as speech and music, and we shall be able both to hear *and* see, using the same broadcast receiver.

There is no limit to the distance to which Television can be transmitted, other than the limits which to-day govern the distance over which wireless telephony can be conducted. All Baird requires for the purpose of the actual transmission of Television

The Receiving Televisor.

is any circuit, wire or wireless, which will transmit intelligible speech. The length of the circuit, or distance between the transmitting and receiving station, does not matter in the least, so long as the requirement of speech intelligibility is met with. The problem does not lie in the transmission circuit. It lies, as we have seen, in the successful transformation of light waves into electrical impulses, and their re-transformation again at the receiver into light waves.

In Television, the received image is liable to electrical distortion if all the apparatus is not properly adjusted, and its effects are almost as distressing as distortion in a loud speaker. The difference, of course, is that it is not music, but the image which suffers.

The image of a face may appear flattened out as in a concave mirror, or a twisted effect may be produced, so that the face seen on the screen may have a flattened nose and a chin higher on one side than the other.

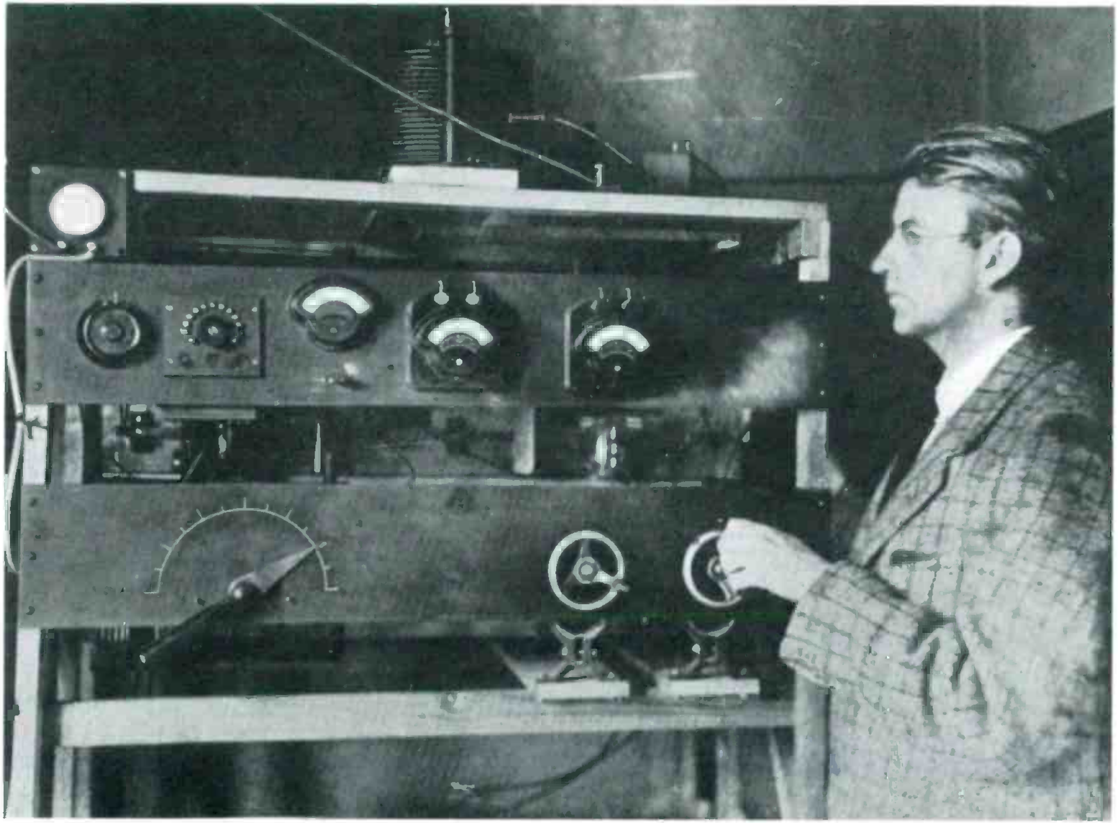
Fortunately, distortion in the Televisor is easily remedied, much more so than in the case of a loud speaker. Adjustment is rendered easier, as each effect can be seen, and the eye is a more reliable measuring instrument than the ear.

Interference, such as is experienced by broadcast listeners, affects Television also when it is transmitted by wireless. With Television, interference takes many peculiar shapes. The whoops and whistles which frequently mar radio reception appear on the Televisor screen as small snowstorms—a mass of whirling white flakes passing across the screen—while interference caused by electric light mains appears as a series of white bands moving up and down the image. Atmospherics appear in the form of white flashes.

The interference troubles inflicted upon ordinary broadcast listeners are not nearly so distressing when seen. A white flash passing momentarily across the screen is not nearly so upsetting and jarring to the nerves as a piercing whistle or a crash of atmospherics in the middle of a musical selection.

As already stated, vast strides have been made since Baird gave his demonstration to the members of the Royal Institution. At that time he had to use such powerful lamps at the transmitting end to illuminate the subject that sitters were almost blinded and burned. Now he has so far improved his light sensitive cell that the intensity of light required is little more than that necessary in an ordinary photographic studio.

There is no reason at all why ordinary daylight should not be used, except that at present the transmitter has not emerged from the laboratory. When the day comes for it to be taken out of the laboratory for the purpose of transmitting an "outside broadcast," ordinary daylight will be used. The Televisor will then be focussed on to the scene to be broadcast just as a camera is focussed for the taking of a picture, according to its distance from the scene or object. The collecting lens, also, will then be fitted with a diaphragm, like a camera, for the purpose of "stopping down" when the sun is too bright.



The Wireless Transmitting Set at 2T.V. It has a power of 250 watts and a wave length of 200 metres.

Another direction in which progress has been made is in that of increasing the size of the image. When the Royal Institution demonstration was given, Baird was only able to televise an image the size of a man's face. Since then he has increased the scope or field of his apparatus, so that he is now able to televise a person's head and shoulders complete, and progress is still continuing at a rapid rate.

A most remarkable thing about Television is that its successful development has been a one-man job. From the very beginning Baird has worked alone, and even to-day he has no technical assistants. Investigators in many countries have been striving to achieve Television for some time, and many have *claimed* to have solved the problem, but have not been able to back their claims by an actual demonstration.

Unheralded by claims, and scoffed at by many sceptics, John L. Baird has "arrived" with his "Televisor," the result of years of patient effort, and actually given demonstrations innumerable to scientists, press men and curious visitors.

Physics, mechanics and optics have been ruthlessly explored to provide this new method of super-communication Since nobody but himself could know exactly what he was doing, and what he wanted to do, and because, during the early stages at least, his processes were secret, Baird *had* to work all alone. He could not afford to pay for expert technical assistance either, so that whenever he entered upon a new phase of development and found himself in need of expert knowledge of some branch of science of which, perhaps, he was in complete ignorance, he had only one alternative—go out to a library, get all the available literature on that subject, and proceed to digest it! Truly a stupendous task, and one which Baird has faced many times, to his greater honour and credit, and to the greater honour and glory of the country which produced such a genius.

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