Regular Television Broadcasting

6D MONTHLY

Television

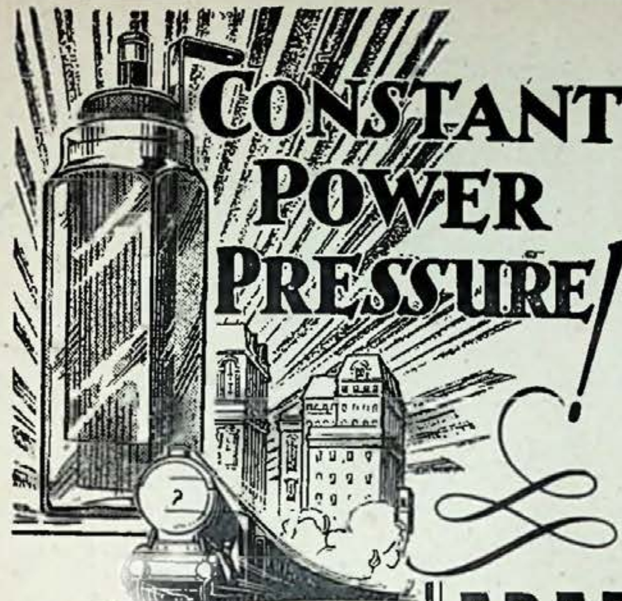
The Official Organ of the Television Society

VOL 1. JUNE 1928 No. 4

BOUND FOR NEW YORK ON THE "LEVIATHAN"

Two representatives of the powerful American group which has purchased the American rights of certain Baird Television patents. Second from the left, Mr. Herbert Pokress; Mr. N. Feldstern (extreme right), both well known in American radio circles. Sir Charles Higham (extreme left) sailed with them.

THE WORLDS FIRST TELEVISION JOURNAL



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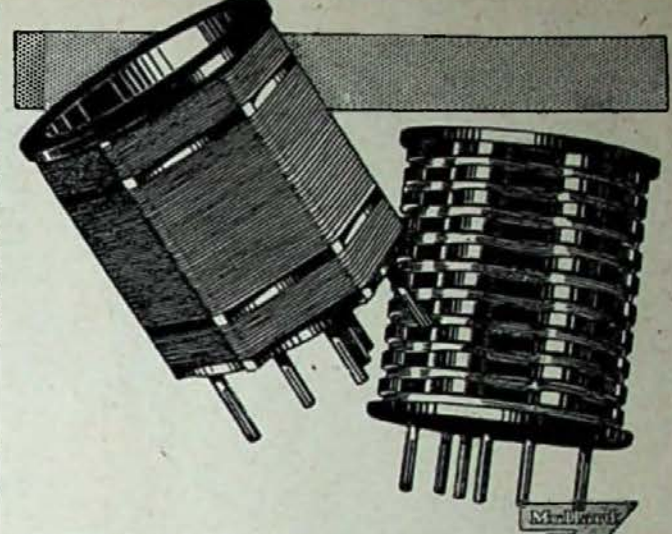

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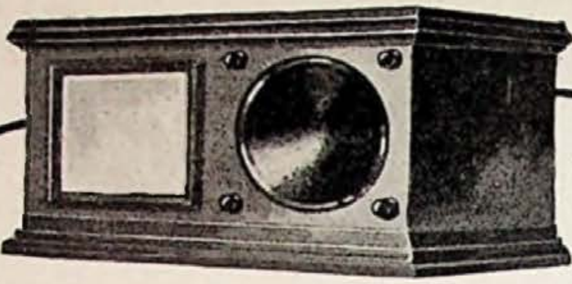
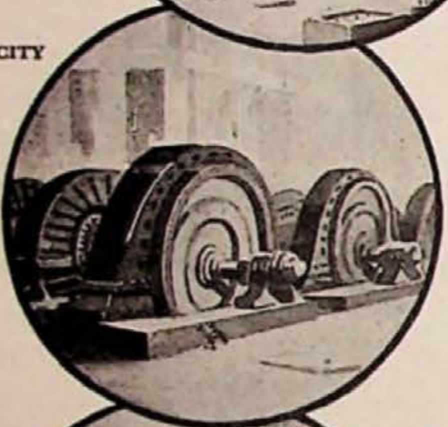


WIRELESS

JUNE 1928

ELECTRICITY



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THE WORLD'S FIRST TELEVISION JOURNAL

The Official Organ of The Television Society

Edited by A. DINSDALE, A.M.I.R.E.

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EDITORIAL

THE past three issues of TELEVISION have met with an amazingly enthusiastic reception, and in spite of the advent of summer, bringing with it the counter-attractions of outdoor pleasures, the interest aroused in television gives every promise of being sustained with unabated enthusiasm.

* * *

THE Television Society is now firmly established and the first general meeting, which will in time to come be looked upon as somewhat of an historic occasion, was held on May 1st, when Mr. Baird delivered the first lecture before a crowded and enthusiastic audience. At the conclusion of the lecture a demonstration of wireless television was given, thus bringing to a fitting ending the first general meeting of the first television society in existence.

* * *

ON our correspondence page we reproduce a most interesting letter from Prof. Cheshire, our well-known and valued contributor on optics, describing this demonstration. In the light of certain criticisms which have been levelled at Mr. Baird's system, Prof. Cheshire's opinion is both illuminating and valuable.

* * *

ALTHOUGH television has been demonstrated on many occasions previously, we think that this demonstration to the Television Society marks the beginning of the time when television will definitely come into the hands of the amateur. The apparatus shown received television which was broadcast from the Baird Company's station in London, and there appears to be little reason why similar equipment should not be in the hands of the amateur experimenter very shortly.

* * *

AGAINST this we have to set the news, reported elsewhere in this issue, that Baird televisors are to be marketed in America first. Although, of course, we should like to be among the first to congratulate the Baird Company on the very satisfactory deal which it has made with the Americans, we cannot help feeling very disappointed that the fruits of British inventive genius may be reaped first in America.

* * *

FROM personal experience we can testify that astute American business men do not spend real money buying a "pig in a poke." In the face of all others, Baird's patents have been chosen as covering the only practicable system of television in existence. That is a triumph for British inventive genius, and we are full of appreciation of the fact; but if home televisors are to be put on the market in America immediately, surely we are entitled to have access to them here in this country, at least simultaneously with their appearance in America.

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SEEN ON THE SCREEN — No. 2.

Baird Televisors for America First

BRITISH INVENTOR'S TRIUMPH

TELEVISION BROADCASTING STARTS IN AMERICA.

In view of the remarks made by Capt. O. G. Hutchinson, of the Baird Television Development Co., during the course of an interview which we reproduce below, we were not altogether surprised when, just as we were going to press, we received the following cable from our New York correspondent :—

"As from Saturday, May 12th, Station WGY will broadcast television programmes three days per week."

For the information of our readers, Station WGY is one of America's greatest broadcasting stations. It has a power of 50 kw., or twice the reputed maximum power of Daventry, 5XX.

IT was with somewhat mixed feelings that we read in the daily press recently that the Baird Television Development Co. had entered into a contract with a powerful American syndicate, as a result of which the Americans acquired certain patent rights in the Baird apparatus. Still more disturbing was the statement of one of the Americans concerned, that within a few months of the return of himself and his colleagues to the States televisors would be on the market over there.

This news seemed to us to be of such importance to readers of TELEVISION that we immediately sought an interview with Capt. O. G. Hutchinson, Joint Managing Director of the Baird Company, whom we found quite ready to discuss the history and meaning of the deal.

"Early this year," explained Captain Hutchinson, "I went to New York to superintend the final details of some experiments which culminated on February 9th in the reception in New York on the 'Televisor' screen of crude but recognisable images of a number of persons sitting in London.

"The demonstration aroused intense interest in New York, and indeed throughout the United States, and I was approached by a group controlling several broadcasting stations who were anxious to be the first in the world to broadcast television. So anxious indeed were they that they were willing to pay well for the privilege.

"Other commercial groups came to see me with a view to acquiring the patent rights in the invention for America. One of the most powerful of these groups was so keen on 'getting in on television' that it immediately commissioned two of its technical experts to investigate the television situation and report on its commercial possibilities. After these experts had seen all there was to be seen relating to television in America they crossed over to Europe and finally came to our laboratories in Long Acre. Their arrival here coincided with the preliminary tests of Mr. Baird's latest 'Televisor.'

"They waited a few days until the tests were complete, and then we gave them a demonstration by wireless and by wire.

Sir Charles Higham, the British advertising expert, photographed on the "Leviathan" prior to sailing for New York recently.

"The result of this demonstration was that they cancelled the reservations already made on the *Mauretania* to return to New York and cabled their principals that they had found real commercial television, and that in their opinion the Baird Television Company had the basic patents of the only practicable system in existence.

A Powerful Group.

"After this the principals of the group entered the scene and we made a deal with them which I think will work out satisfactorily to all concerned.

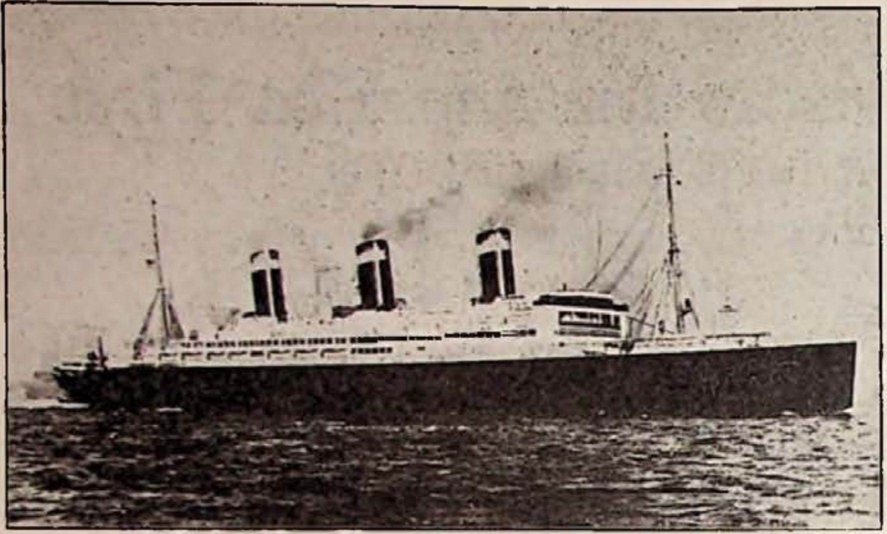
"The group concerned is extremely wealthy and powerful in the field of American radio. It controls a vast chain of radio stores extending throughout the United States, Canada, and Mexico. It also controls several radio broadcasting stations, and is arranging to purchase others which will immediately be put into service as television broadcasting stations.

"The manufacture and sale of receiving 'Televisors' for home use will be commenced at once.

"A special radio-television station is being erected on Long Island, near New York, for the purpose of co-operating with our trans-Atlantic station over here which is now ready, thus bringing two-way television between London and New York a step nearer.

"Under the terms of the contract we retain a 50 per cent. interest in the profits of the American, Canadian, and Mexican companies which are being formed, and we get the benefit of any improvements which may be acquired or developed by the American companies, while they on their side get the benefit of any improvements made by Mr. Baird in this country."

In answer to our inquiry as to the amount of money involved in the



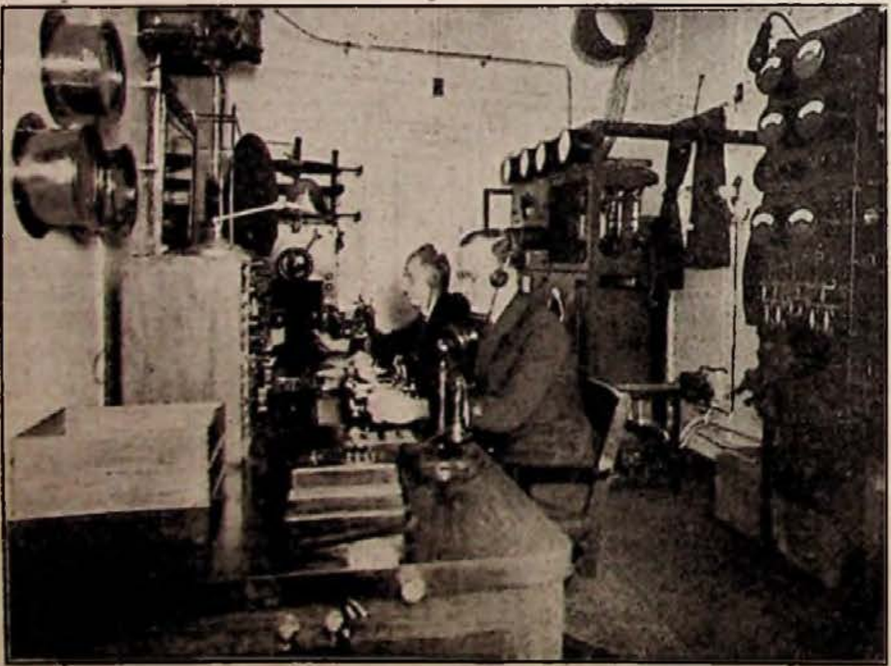
TO BE THE WORLD'S FIRST MOBILE TELEVISION STATION.
The "Leviathan" leaving New York. (*Photo by courtesy of U.S. Lines.*)

transaction, Captain Hutchinson replied that he could only say it was a large amount and considered very satisfactory by the directors of the Television Company.

Sir Charles Higham, the well-known publicity genius, left for America in company with the American representatives, and we understand he is handling for them certain publicity matters on the other side. The party sailed on the United States liner *Leviathan*, which ship has been selected to be the first mobile television station. Negotiations are in hand with the object of equipping the *Leviathan* with both a transmitting and receiving apparatus.

Captain Hutchinson concluded by stating that "television should now go ahead by leaps and bounds. Our American friends are real live men, and as there is no broadcasting monopoly over there I would not be a bit surprised to hear within the next month or so that regular television programmes were being broadcast; and I believe that once they get to that stage improvement will follow swiftly on improvement, even more rapidly than was the case in the broadcasting of sound.

"I do not wish to overstate the case in any way, but our American cousins have certainly got a go-aheadness about them that we would, I am sure, do well to emulate."



The Wireless Room of the "Leviathan," which will be closely linked with television in the near future.

Apparatus Received.

We have received from Messrs. Economic Electric, Ltd., a sample E.E.C. motor which was designed for driving the two rotating discs incorporated in the simple televisor described in our first two numbers.

Readers will recall that this machine demonstrated the principles of television. On the transmitting side two discs were employed, one exploring the image while the other is described as a light interrupting disc. Both discs are rotated by means of small motors deriving power from an accumulator. It is required of these motors—two being necessary as one is arranged for each disc—to rotate at an even speed and at the same speed.

The E.E.C. Motor is rated as a 4 to 6-volt motor capable of running efficiently at 2,000 revolutions per minute. We notice that it consists of a three-section series-wound armature mounted on a substantial silver-steel drive shaft. The armature core is built up of charcoal iron laminations. There are two pole faces which form a substantial housing carrying the bearings, field coil, etc. The current is supplied to the armature through copper gauze bushes to a disc type commutator. The necessary terminals for the current supply battery are conveniently placed on the top of the motor. A solid ebonite block carries these terminals. The overall dimensions for the motor are $2\frac{3}{4}$ in. high, $5\frac{1}{2}$ in. long, and 3 in. wide. These measurements convey its compactness.

On test we found the E.E.C. Motor satisfactory. It ran smoothly and silently even at maximum speed. This particular piece of apparatus is obtainable from a number of suppliers of television components whose names and addresses are to be found in our advertisement columns. It is listed at £1 1s.

The Television Society

Report of First General Meeting

On May 1st the first general meeting of the Television Society was held at 8.30 p.m. at the Engineers' Club, Coventry Street, London. As announced at the last meeting (which was a purely formal one, to discuss Society business), Mr. J. L. Baird honoured the Society by delivering a lecture on television, at the conclusion of which he demonstrated the reception of television by wireless. Members attended in full strength, taxing the accommodation of the lecture room to the limit.

During the course of his introductory remarks the Chairman, Dr. C. TIERNEY, D.Sc., said that we had the pleasure that evening of meeting one whose name is associated with television perhaps more than any other name with which we are familiar in this country. He referred, of course, to John L. Baird. It was a compliment which we all highly appreciated, since probably no one had done more to advance the science of physics to the art of television that Mr. Baird, our own countryman.

The Cinderella of Physical Science.

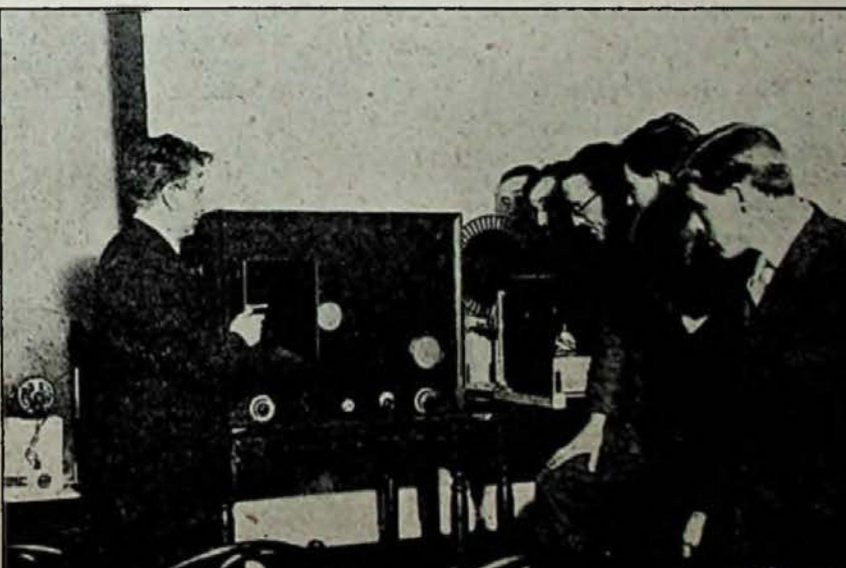
So far as physics was concerned, television was perhaps the Cinderella of physical science. It was not yet fully achieved, though the promise that it held in store was one that we had no apprehension about whatever. It was actually within reach, and it only remained now for sufficient concentration and application of known laws to the applied arts in order to achieve the result that was so earnestly sought for.

It was not many years ago since we tinkered about with carbon microphone, coherers and de-coherers, and had no knowledge that we should achieve, in the art of transmitting sound, what is known as the "broadcasting" of to-day. He wished to say at this point that it was due almost entirely to the amateur that that fine art of applied science was accomplished in the manner that it was to-day.

Similarly, television was the latest of current advances, and one of which we might feel justly proud. He hoped that, as a result of the lecture which we were to hear that evening, we should receive that stimulus and that encouragement which would not allow us to get into that despondent position that so many seemed to have been in, and which, as he happened to know, Mr. Baird himself had found himself. In spite of his ups and downs, in spite of his successes and disappointments, in spite of his hopes and fears, Mr. Baird had actually accomplished the transmission of light in much the same way as we were accustomed to receiving the transmission of sound. Therefore he anticipated with the audience the pleasure of hearing from Mr. Baird himself something of current advances in the art of television, and would call upon him, without further delay, to give us his lecture.

Mr. J. L. Baird.

Mr. J. L. BAIRD: Mr. Chairman, Ladies and Gentlemen, it gives me very great pleasure to be here to-night, to find such a large audience, and to see how successful this Society has been in such a short time in gathering together so many. The science of television is very new, and it is, in some respects, surprising how



Mr. Baird describing to Members the actual Televisor which was used in the Transatlantic Tests.

great an interest has been aroused in this new subject. I hope to-night to give you a brief account of the problems and difficulties met with and of the methods used in overcoming those difficulties.

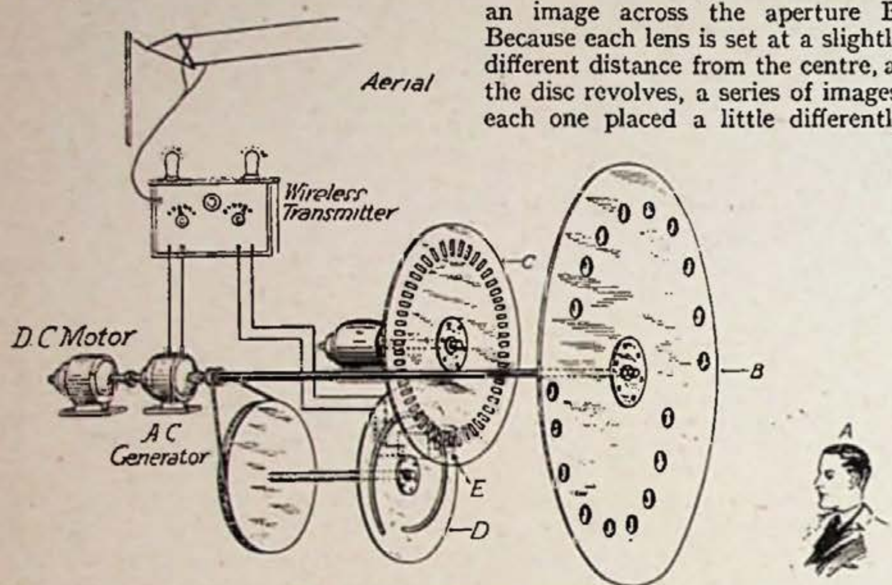


Fig. 1.—Early form of Transmitter.

The general principles of television are, I expect, known to most of you. The essential principle consists of passing an image of the object, as seen, over a light-sensitive cell, and thus turning the scene into a series of electrical impulses; transmitting these impulses, just as the electrical impulses corresponding to sound are transmitted, and at the receiving station reconverting those impulses into light.

The First Problem.

The first problem is to devise an apparatus to cause the image to pass over the cell, and to cause the image to pass over the cell with sufficient rapidity. I think the easiest way perhaps to explain this will be to show a lantern slide of one of the first machines used. The apparatus I am going to show you is one of the very simplest forms of exploring device. It has very serious limitations, but it does show quite clearly the methods employed. Those methods are much the same to-day, the only difference being an increased fineness in the grain.

The disc B in the diagram (Fig. 1) is simply a flat disc with lenses set round the circumference. These lenses cast an image of the object on to the aperture E. Each lens casts an individual image. This disc is revolving roughly at 800 revolutions per minute, and as it revolves each successive lens casts an image across the aperture E. Because each lens is set at a slightly different distance from the centre, as the disc revolves, a series of images, each one placed a little differently from the preceding one, passes down across the cell aperture. The result is that the image is split up into a succession of strips, and these strips are caused to pass rapidly over the cell.

Before the light reaches the cell it is split up again by the disc C. This disc is simply serrated into a succession of slots, and it causes the light to fall in a series of pulsations on to the cell. If this disc alone were used possibly only sixteen different strips of the picture would be obtained, and to obtain a finer grain we used the second disc D, which is geared to the lens disc with a reducing gear, the spiral passing in front of the slotted aperture. The result is that as the disc revolves the slot moves laterally from side to side, due to the spiral opening.

If this is geared down 5 to 1, it means that there are five different positions with each revolution, that is to say, five times the number of strips, and the only limit to the sub-division of the image is the speed of the machine. The effect of the disc is simply to enable you to get what amounts to as big a disc as you like without increasing the size of the disc B.

What happens then is that the image falls in many little sections on the cell E, and sets up a pulsating current. The pulsating current is transmitted by wireless to the receiving station and there controls a source of light.

Synchronism.

You notice that this machine is driven by a D.C. motor and to the shaft is coupled an A.C. generator. The motor supplies the driving power and the generator sends out an alternating current. The alternating current is used for synchronism. It is transmitted along a separate channel to the receiving station, where it controls the receiving motor so that the two machines keep exactly in step.

The second slide (Fig. 2) shows the receiver. The receiver is identical with the transmitter, with the exception that the perforated disc is not used and the light-sensitive cell is replaced by a glow discharge lamp. The current from the light-sensitive cell controls the light of the neon tube, so that it is bright when there is a strong current, dim when there is a low current value, and out altogether when there is no current.

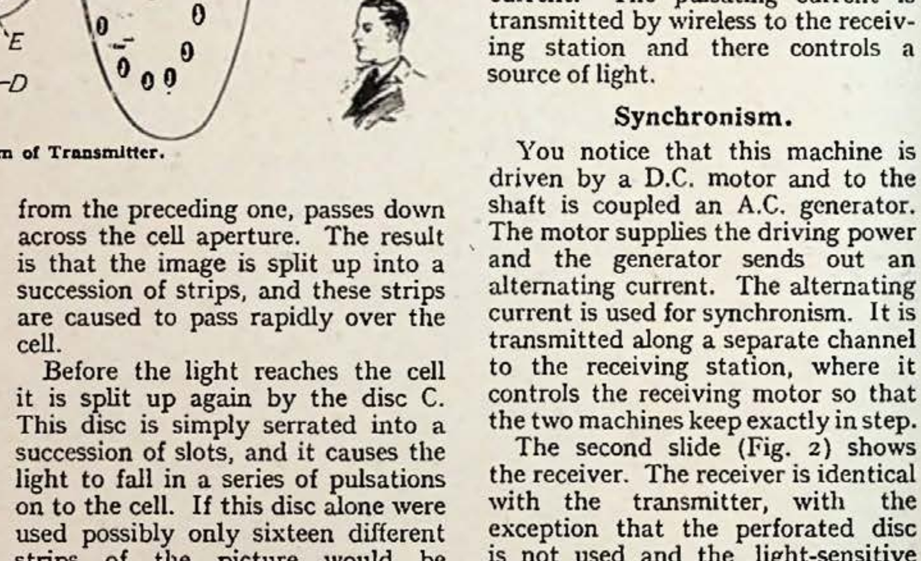


Fig. 2.—Early form of Receiver.

The neon tube is placed behind an aperture similar to the aperture to the cell in the transmitting station. This machine revolves exactly in step with the transmitting machine. I might explain the operation a little more closely. When starting a machine of this kind the motor runs the mechanism up to speed, an alternating current from the transmitter is connected to one pole of the switch and the other pole is connected to the input of the motor. As they get closely to synchronism the lamp connected across the switch glows and goes out, the period becoming longer, until the machines get into step, when the lamp goes out altogether and the switch is closed. That is the normal process of synchronism, and that was the process used with these wireless types of machine.

Mechanical Limitations.

Looking at a machine of that type, it is clear that there are obvious limitations. The first one is that if the speed is increased, mechanical considerations soon set a limit. After a speed of 2,000 to 3,000 revolutions per minute has been reached, a disc of this kind becomes dangerous, and that sets a very definite limit to the grain of the picture. Many people make the statement that it is quite impossible that any mechanical form of exploring device could give television a fine grain. As a matter of fact that is not the case. There are at least two methods whereby a grain of almost any desired fineness can be obtained, using purely mechanical exploring devices.

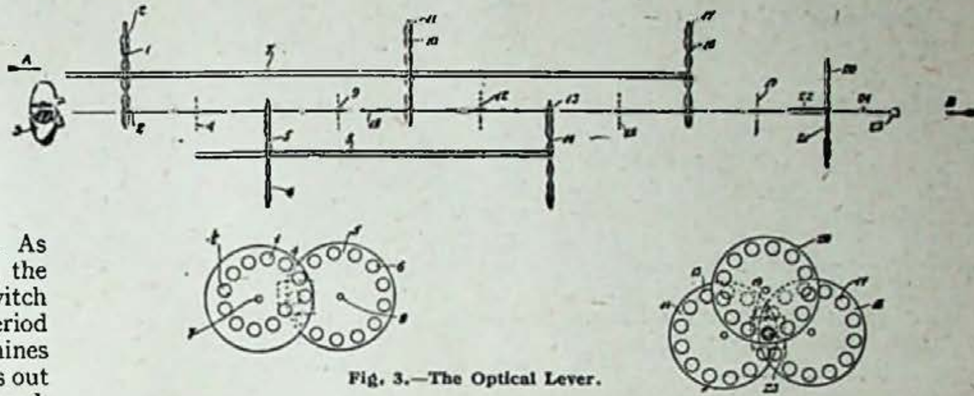


Fig. 3.—The Optical Lever.

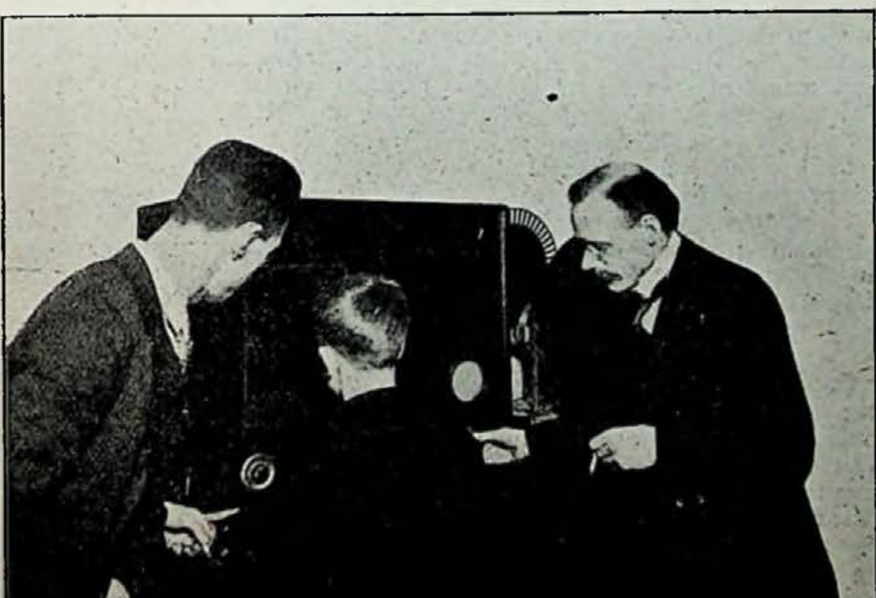
The third slide (Fig. 3) shows one method of obtaining a grain of any desired fineness by means of a purely mechanical exploring device. The upper shaft carries three lens discs. If you follow the operation of this apparatus, the action of the first disc is to throw an image on to the ground-glass screen. As the disc revolves a succession of images passes over the screen, one for each lens. This ground-glass screen is again explored by the second lens disc 3, so that on this second ground-glass screen an image of the first ground-glass screen passes up with a velocity dependent on the velocity of the second lens disc. The result is that the two speeds are added, so that the image passing on to the screen is moving with twice the speed of the image on the first ground-glass screen.

Although the speeds of the two shafts are the same the process is again repeated by the third disc, which throws the image on to a further ground-glass screen. Then again it is shifted by the fourth lens disc and the fifth lens disc, until finally, on the final ground-class screen we have an image passing across it with five times the speed of the first image. Thus, without increasing the mechanical speed of the apparatus, we have increased the speed of the image five times.

Screens Unnecessary.

The ground-glass screens are shown in the picture, but they are shown merely to illustrate the operation of the device. The image is projected equally well without the ground-glass screen at all. In such an operation there is a loss of light, but the loss need not be serious. It means a loss passing through five lenses, but with modern lenses that loss is not very great. That represents one possible solution of the problem, using purely mechanical exploring devices.

There is another way, a much more straightforward and much simpler way, that is, to use, instead of one light sensitive cell, a number of light-sensitive cells, and to transmit the image in a succession of zones. That is to say, instead of transmitting one picture, transmit several, and reproduce them side by side. That is a very practical way of achieving the



The Chairman (right) examining the Televisor.

result, only of course it means a separate channel for each image, and that is certainly a very serious drawback.

Increasing Cell Activity.

But if we can increase the cell activity, it may not be quite so serious as it is now. If you consider this apparatus acting very rapidly, another difficulty at once arises, that is the difficulty of obtaining a sufficient response from the light-sensitive cell. That was always one of the big difficulties in television. The light thrown back from a human face is extremely small, and when you consider the rapid traversal of the image over the cell, you will see that the cell has to react to an infinitesimal quantity of light, and it has to react very rapidly. That means that to overcome this difficulty we have to use either immensely brilliant lighting, or increase the sensitiveness of the apparatus. Or, there is another way out of the difficulty.

Referring to Fig. 4, let me explain another method of obtaining intensely brilliant illumination without inconveniencing the subject. In this method the process is reversed. Instead of causing an image to traverse the cell, we explore the object with a point of extremely intense light. As the light is passing continually over the person being transmitted, the total brilliancy is very small; it is only proportionate to the area of the spot divided by the area of the picture, and very intense illumination can be used by this method without causing inconvenience to the sitter.

The Light Spot System.

This drawing (Fig. 4) shows one of the general methods of carrying out the scheme. You see here a light-sensitive cell, the source of light, and an exploring device. The latter causes a point of light to move backwards and forwards across the object. The light is thrown back and falls upon a stationary light-sensitive cell. One disadvantage in that system is that to secure efficiency the cell must be very large, and to overcome that we have what is marked here as Fig. 2.

In this arrangement a cell of ordinary dimensions can be used, and still you get an efficient exploring device. The source of light explores the object and simultaneously the object is traversed over the cell, so that at any instant the point of the object falling on the cell is the same point which is being illuminated by the point source of light. The result is, that the full quantity of light is received by the cell at any instant, and the device gives a very efficient optical arrangement.

This method, which I might call the light spot method, has the advantage of being very simple and very effective; but it has also the disadvantage that it is only

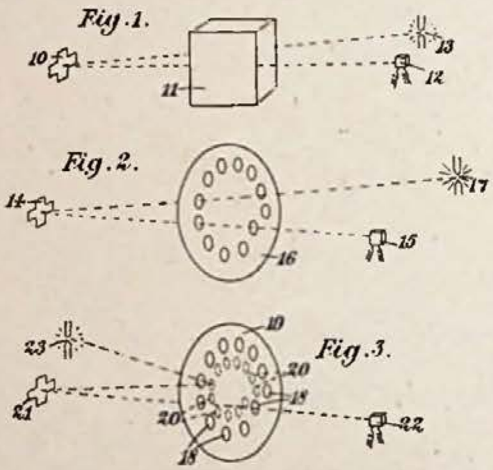


Fig. 4.—The Light Spot System.

applicable to restricted scenes. For example, you could not use a light spot on an outdoor scene. With television in its present state that problem has scarcely arisen. We cannot yet transmit the Boat Race, nor any extended scene, and for restricted scenes the light spot method is quite sufficient. The final apparatus will, I think, unquestionably use ordinary flood lighting.

I have indicated now two methods of obtaining a finely grained image and obtaining a sufficient intensity of light without damaging the subject. Another problem remains, and that is rather a difficult problem. I refer to the difficulty at the receiving station of obtaining sufficient brilliancy from the light source. The received image in a television apparatus is constructed from a moving point of light, and this single point of light has to illuminate an entire screen, and to illuminate it with sufficient brilliancy. If the screen is made very large and if the detail remains the same, the ratio of the area of the point of light to the screen becomes very big indeed, and there is not sufficient brilliancy to adequately illuminate the screen.

Now, the light sources used at present are glow discharge lamps. By constructing these lamps in various forms, surprisingly intense light can be obtained; but a limit to this is reached, and that limit is reached long before a screen in any way approaching the size of a cinematograph screen is employed. In the future apparatus, where it is desired to throw on a screen an image of a very large thing, some other form of lighting will have to be used.

Reproduction on a Large Screen.

I will show, in the next slide (Fig. 5) an alternative method of reproducing an image at the receiver. Instead of using a travelling point of light, a commutator is used, revolving with the receiving disc and feeding the current from the transmitter light-sensitive cell through a bank of light sources. As the commutator revolves, each little of light is lit in succession. If the brush and the transmitter revolve slowly, one lamp after another lights in succession and produces the impression of a point of light traversing the screen. As the discs are speeded up, the image is reproduced on the bank of lamps. That is obviously a very complicated arrangement, because it means an individual source of light and an individual commutator section and an individual wire for each point of light in the picture.

As there must be several thousand points at least on the received image, it means a very large commutator and a very large number of light sources, wires and connections. But it is not altogether impracticable, for by using modern forms of commutator there is no reason why images on a very large scale should not be reproduced by that method. In fact, it was actually successfully employed by the American Telephone and Telegraph Company to show an image to quite a large audience. They used this precise method. They did not mention that it had been patented before, but they managed to get, I believe, recognisable images on a large screen, using a commutator and a bank of light sources.

There is another way of getting a

large image, and perhaps a more practical way. If we can have at our disposal a number of channels of communication, as I indicated before, using a number of cells and a number of light sources, transmitting the picture in a series of adjacent zones, that gets over all the difficulties; but it means a number of channels of

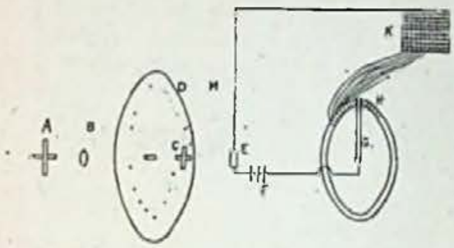


Fig. 5.—A method of reproducing an image on a Large Screen.

communication, and these, at any rate in the present state of the ether, are not available. At some future date they may be, and in that case the above method will be available. By using that method, an image of almost any desired size can be obtained. The lamps can be made, of course, as big as you like, and the screen can be made as big as you like.

Ordinary Incandescent Lamps Suitable.

A further point arises. The lamps used in this screen need not be instantaneous in their response; they can have a time lag, so long as the time lag does not exceed a tenth to a twentieth of a second. Each lamp has the whole period of traversal of the picture in which to heat up and to cool down. The ordinary incandescent lamp would be available for this form of reproduction.

Now, Ladies and Gentlemen, I would like to say a few words on some of the developments arising out of television. The first of these developments (which is being confused quite a lot with death rays and other things) is noctovision, using infra-red rays in place of visible lighting.

In the first experiments with television I found the very greatest difficulty in reducing the intensity of the light, and that led to experiments, first of all, with ultra-violet rays. Then, finding that ultra-violet rays were most objectionable to the sitter, and also very objectionable in that the lenses filtered out quite a big proportion of the active rays, I turned to the other end of the spectrum, to the rays below red, and endeavoured to use those rays.

The infra-red rays have very great penetrating powers and no bad effect on the sitter; but they have also only a very small photo-electric effect, and it was quite difficult to obtain results using infra-red rays. But by increasing the optical efficiency of the apparatus and the sensitivity of the cell, I obtained results using these rays in place of light, so that images could be seen with the object in total darkness.

Invisible Ray Experiments.

For television purposes, there is no advantage whatever to be gained by using infra-red rays. In fact, there is very considerable disadvantage. To commence with, it is extremely difficult to use these rays, and secondly, it is very inconvenient for the sitter to sit in total darkness. Again, infra-red rays give the wrong colour values. Red appears almost as white, and blue does not appear at all. The effect is to give a rather ghostly appearance to the image of the person being transmitted.

Although these rays are of no advantage for television, and although the noctovisor is, for television purposes, no advance, but rather the reverse, it has other potentialities quite apart from television. For example, in war-time the development of a means of vision which would enable the attacking force to be seen without them being aware of it has obvious advantages.

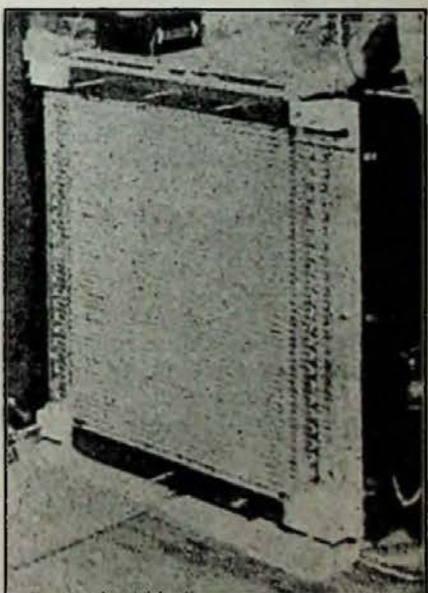
Fog Pentrating Powers of Infra-Red Rays.

Apart from that, there is another and useful commercial possibility, which depends upon the fact that infra-red rays penetrate fog. Fog, or mist, is penetrated by light, or by ether waves, proportionately to the fourth power of the wavelength. That is to say, short waves are dispersed very quickly and long waves have great penetrative power. The old observation, that the sun turns red when it sets is simply an indication of this phenomenon. In the case of the setting sun the light is passing through a great deal of fog and mist and atmosphere, and all the visible light, except the red, is filtered out. The infra-red rays possess that property proportionately and they penetrate fog better than the red rays, just as the red rays penetrate fog better than the blue rays. This was drawn to my notice in a rather peculiar way.

Invisible Smoke.

I gave a demonstration of the noctovisor to the Royal Institution, and one of the members at the previous demonstration had seen the office-boy smoking. He wanted to see a repetition of this with infra-red rays. We had the boy in front, and he smoked, but we could see just a little wisp of the smoke, and though he puffed vigorously nothing more came through. I did not realise at the time what the cause of that was, and I was very disappointed, but later on it occurred to me that the explanation was perfectly simple. The smoke from the cigarette was perfectly transparent to the infra-red rays.

In developing that idea we put a dummy's head in a thick artificial fog, and the dummy's head could be seen quite clearly on the noctovisor



A form of large screen built along the line indicated by the lecturer. It consists of a long neon tube, bent to and fro, and provided with an enormous number of electrodes.

screen. That opened up at once a possible use for a development of this apparatus in giving actual vision through fog. That remains to be developed, but it does open up a possible use in the mercantile marine and in aviation for such a device, and we are just now developing that branch of television.

Talking of those uses, I might mention another side-line of television, and that arises from a phenomenon in connection with the transmitting apparatus. Every object in front of the apparatus is, of course, turned first into a pulsating electrical current. If this current is listened to with a head-phone, it is heard as a sound, and you can distinguish the sounds of different people's faces and hear them moving about, and you can distinguish very readily, for example, the difference between the sound of a face and the sound of a hand. There is no possibility of mistaking that. The hand gives a very marked characteristic sound quite different from the sound of a face.

Two different faces also give different sounds, though the sounds are very much alike, unless you have faces that are very characteristic; but you can tell the difference if you have chosen carefully, and you can hear movements of the face quite clearly. You can hear the mouth open, and you can hear the head turning from side to side, or movements such as that.

Recording Image Sounds.

It occurred to me to put these sounds on to a gramophone record and to play this record back into a television image by means of a magnetic pick-up, so that the markings on the record would be turned back into electrical undulations, which could be applied to the television machine, thus turning them back into light. It is, of course, necessary to revolve the television machine exactly in synchronism with the record, in order to get the image back on the screen. That sounds quite a simple matter, but in practice it did not prove to be nearly so simple as it sounds.

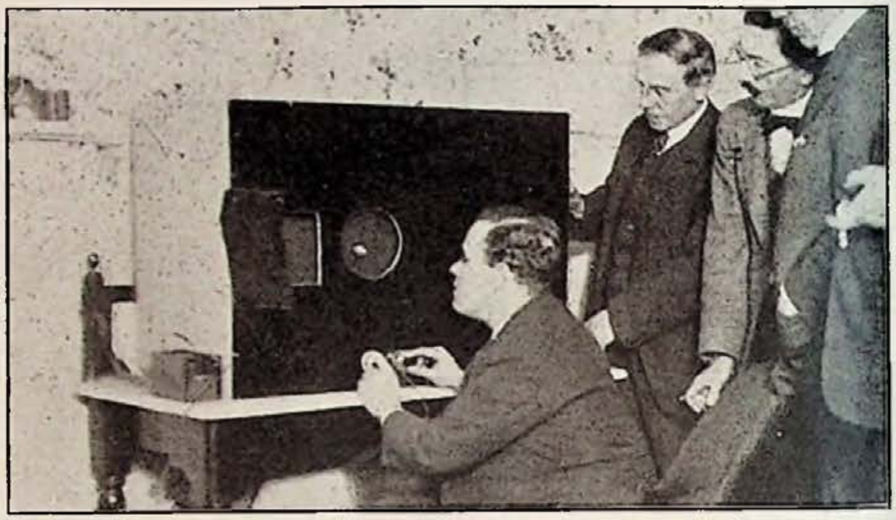
To commence with, the gramophone had to revolve exactly in step with the television receiver, and that requires very great precision. The ordinary bearings used in a gramophone are quite useless; there is far too much play and far too much inaccuracy, and it was only after some time that we were able to get images back; but we have now succeeded in getting those images and we can see from a record at the present moment a crude smudgy replica of the person whose image has been put upon the gramophone record. I hope it will improve. At the present time it is more of a curiosity, but it does open out considerable possibilities.

The phonograph, or, rather, the speaking film, gives you an image—a very good image—of the person singing and lets you hear the voice at the same time. By using the phonovisor you can do the same thing, putting an image of the person singing on one spiral of the record and the voice reproduction on another spiral, so that the person singing can be seen at the same time from the same record. Such a device would have the advantage over a speaking film, in that it would be very much simpler. As television develops, phonovision must develop simultaneously, and I do not think it is too optimistic to hope that this device will have a practical use. In any case, we are spending time just now in carrying out work along these lines.

The Question of Distance.

There is one further point that should be brought out, and that is the question of distance. The question of distance merely resolves itself into the question of sending an electrical impulse, either over a telephone wire or by wireless. Strictly speaking, it does not constitute a television problem—it is more a problem of wireless technique, or of telephony, although the frequencies dealt with in television are considerably higher than those dealt with in any telephone circuit.

On the other hand, we did transmit last year a quite recognisable image between London and Glasgow. I did not myself see the image because I was at the London end, but when I came in front of the transmitter I was at once recognised by Professor Taylor Jones and Sir John Samuel, who were in Glasgow and who spoke to me over the telephone. The line used for the television transmission was an ordinary overhead line without any special balancing coils whatever, but it was an extremely good line, and overhead all the way. That represents the longest distance ever sent over a telephone line.

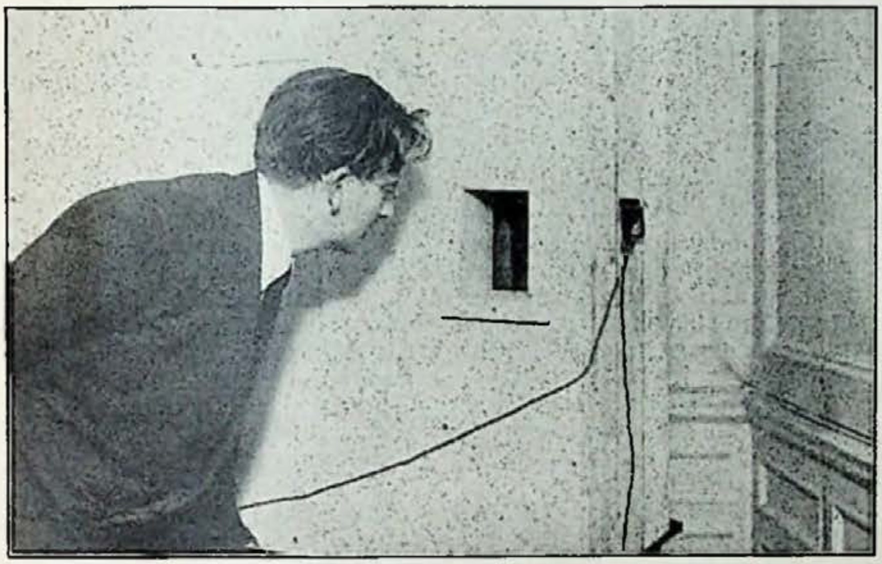


The scene at Glasgow during the London to Glasgow Television experiments to which the lecturer referred. Professor Taylor Jones is the third figure from the left.

Experimental Wireless Transmissions.

With regard to wireless, the problem is very similar. It is a question of sending wireless signals, and sending them in an undistorted fashion. We carried out last year experiments with short-wave transmitters at Coulsdon, using a 45-metre wave-length. We sent the television signals by land line from Long Acre, in the heart of London, to Coulsdon, about fifteen miles out. We had a power of only 2 kilowatts, and we had trouble with fading, atmospherics, and interference, but we did get images across the Atlantic, and these images, although very small, were recognisable. That demonstration was repeated in mid-ocean during the return journey.

These demonstrations at least definitely show that the apparatus used for television need not necessarily be cumbersome, or complex, and they do show that the television receiver can be operated without an army of technical assistants. The problems which remain are to perfect the detail, to increase the size of the image, and to render the television apparatus sufficiently simple, cheap and reliable, to be placed in the hands of the public.



Mr. Baird photographed while making adjustments to his Televisor prior to the demonstration.

Prophecies Dangerous.

I will not make any prophecies—that is always dangerous—but I may make perhaps an indefinite statement and say that the time when this apparatus will be in the hands of the public is very near. If fortune and the B.B.C. permit, after the conclusion of the lecture I may be able to show you some experiments from our Station at Long Acre. The erection of the wireless poles in not yet complete, but I will try and show you something to-night. We put up a temporary wireless and rigged up the apparatus, but I do not know whether we will be able to get a satisfactory image through.

That, Ladies and Gentlemen, concludes all I have to say to you.

While Mr. Baird was getting his apparatus into working order, Dr. TIERNEY rose to propose a vote of thanks to the lecturer. During the course of his speech he referred to a very prevalent misapprehension that the perfection of television will mean that the privacy of the individual will be violated. This idea, he said, was quite erroneous, as he felt sure all those present fully realised. There was no possibility of anyone being inspected at a distance by television without his consent.

He felt sure that the audience would agree with him, after what they had just heard, that we are standing on the very brink of some notable developments and discoveries and of some very remarkable revelations. He was sure that development and achievement would arrive very much more speedily now with the knowledge already ascertained than would otherwise have been possible had it not been for the persistence and the patience and dogged determination of men like Mr. Baird, who had devoted their lives to the study.

Demonstrating under Difficulties.

Dr. Tierney explained that the demonstration of television which Mr. Baird was going to endeavour to give was by wireless. A temporary transmitter at Long Acre, about half a mile away, would broadcast the television impulses, and these would be picked up by a wireless receiver fixed up temporarily in a corner of the room. This arrangement was subject to much interference from a harmonic of 2LO, and he asked those present to make allowance for this and other difficulties under which Mr. Baird was working.

He concluded by asking the audience to give expression of its thanks and appreciation to Mr. Baird for his lecture.

"Television a New Cultural Movement."

Mr. KEAY, who seconded the proposal, referred to Mr. Baird's "very cautious, that characteristically cautious intimation that it will be possible, we hope at an early date, to have available apparatus for us to use." This was not only interesting from the technical standpoint, but also from the æsthetic standpoint, because—"We see in television a new cultural movement."

He thought he was not giving away a secret when he said that the definition of a television image to-day was so clear that—"You can see the whites of the eyes of the person being televised and can count the teeth."

He hoped that all present would do their utmost to develop the Television Society, to make it even more real than it was at present—though it was a remarkable growth in a short time—to assist where possible to set up provincial centres so that they might be linked up with the national movement.

Following the lecture a model "Televisor" was shown in operation. Some trouble due to interference was experienced at first, but subsequently the image of the Secretary of the Engineers' Club, which was being tran mitted from Long Acre, was successfully received.

Interest in Television at Walthamstow.

At a recent meeting of the Committee of the Walthamstow Amateur Radio Society the question of the formation of a local branch of the Television Society was discussed.

The general opinion of the meeting was favourable to the idea, and provisional arrangements were made for the carrying into effect of the proposal at the first autumn meeting of the Society, which will be held at the end of September.

Interested readers living in the Walthamstow district are invited to communicate with Mr. L. RAXWORTHY, 20, Queen's Road, Walthamstow.

[The Editor will be glad to have reports of activities in other areas.]

America Leaves Us Behind Again

Television for the Home—but not OUR Home

By R. F. TILTMAN, F.R.S.A., A.M.I.R.E., A.Rad.A.

Author of "Television for the Home," "Wireless Without Worry," Etc., Etc.

FROM brief notes which appeared recently in the press—in some papers only in the financial columns—many people know that the Baird Television Development Company has sold to an American syndicate certain rights of the Baird television system.

The general public, however, certainly does not realise to the full exactly what this fact implies, and the object of this Article is to bring to light without delay the regrettable states of affairs which will be realised to the full by the "man in the street" before many weeks have passed.

To put the matter briefly, within a few weeks now the organisation which has acquired the American rights of the Baird Television system will be selling home "televisors" throughout the U.S.A., and will commence a regular television broadcast service from a number of radio stations.

Thus television will enter American homes—but what about British homes?

Britain's Prestige.

It is a universally recognised fact that we have for years led the world in television research and development. The American press, in common with that of all other countries, has freely recognised Mr. J. L. Baird, the British inventor, as the first man in the world to demonstrate true television, and at no time in the past three years has the supremacy of his system been seriously challenged.

Furthermore, those who have had opportunities of witnessing the gradual improvements and developments of Mr. Baird's apparatus in the past two years have looked forward with confidence to the day when the system would be sufficiently advanced to permit the marvels of broadcast sight to enter into the home just as the broadcast voice has brought entertainment and interest to millions.

It has been confidently predicted that very shortly a television broadcast system would be started—for it is not usual to hold back a development of this sort from the public until perfection is reached, as witness the early and crude state in which inventions such as the phonograph, bicycle, motor-car, aeroplane, etc., were put into general use; or in more modern times the introduction of the broadcasting of sound, and of "listening in" by means of crystal sets.

Therefore, in view of the fact that television is an all-British invention, people here have confidently awaited the commencement of a broadcast television service in Great Britain immediately the Baird system was sufficiently developed to permit its introduction to the public.

The Power of American Gold.

Now that an immensely wealthy and powerful American organisation has seen fit to purchase for America (after their technical and patent experts had reported upon it after witnessing demonstrations) certain rights of the Baird system with a view to commencing an immediate service for the public it is perfectly obvious that the system *is* sufficiently advanced for that purpose.

As the Baird system *is* sufficiently advanced to warrant its being introduced in an early form in the home, why is no television service being started in this country, the country of origin of the invention?

That is the question which the public will ask—which the public is entitled to ask—and when the facts are more fully realised the voice of the public on this point will be loudly heard!

Is Mr. Baird to blame for this state of affairs?

I am perfectly sure that this is not the case. As a matter of fact, I happen to know that it is due to Mr. Baird's patriotism that the invention was developed so far in this country, for, early in 1927, representatives of an American Corporation tried hard to take him and his world rights back to America in order to develop the whole system from that side of the Atlantic.

No. The fault lies with conditions over which the inventor has no control, conditions which one thing alone will change—public opinion.

The American organisation which is starting a television service controls a number of radio broadcast stations in that country.

There is the explanation. To develop a television service in its quickest and most satisfactory manner it is really necessary for it to be allied with existing broadcast telephony, and there is no difficulty about that in America where there is healthy competition in broadcasting instead of a monopoly.

A demonstration of television was carried out on board the "Berengaria"—one of our largest liners—on March 7th. But owing to the broadcasting restrictions over here it has not been possible to follow this up.

"Leviathan" First.

Thus we find that the "Leviathan," of the United States Lines, is to be the first ship in the world to be fitted with a permanent Television installation. This is again made possible by the fact that, in America, the control of broadcast stations is in the hands of private enterprise.

How absurd for Britain—the birthplace of television—to sit calmly by while other countries reap all the benefits of a television system devised by British brains.

Radiation—Visible and Invisible

By Dr. J. A. FLEMING, F.R.S.

IF any of the leading physicists in the mid-Victorian age had been asked whether they knew anything about the nature of a ray of light and how it is produced, they would have replied: "Why certainly! Light consists, physically speaking, of transverse vibrations in the ether, and is produced by the rapid vibrations of atoms which, like small tuning-forks, vibrate and produce ether waves of the same frequency as the atomic vibrations."

We now think that the above statements are of questionable accuracy. We have no direct experimental proof that there is an ether, and we have good reasons for thinking that the rate at which an atom or any part of it can oscillate has no simple relation to the frequency of the resulting emitted radiation such as was formerly assumed.

In view of the use in television by Mr. Baird of a certain range of radiation which cannot directly affect the eye, it may be useful to set out some modern knowledge on the production of radiation, visible and invisible.

Structure of Atoms.

First, as regards the structure of chemical atoms, the hypothesis widely accepted at present is that they are built up of two kinds of more elementary particles, named protons and electrons, which, taken collectively, form the so-called positive and negative electricities.

The protons with some electrons are united in a very small and dense nucleus of the atoms and the remainder of the electrons revolve round the nucleus in various orbits called the K, L, and M, etc., orbits. The number of these planetary electrons, or the excess of the number of protons over and above the nuclear electrons, is called the atomic number of the element.

The proton has about 1,800 times the gravitative mass of an electron, but they have equal electric charges of opposite sign. Hence protons attract electrons powerfully; and electrons repel electrons. Both protons and electrons may be considered to be centres from which a system of lines of electric force radiate, the direction of the lines being opposite in the two cases (see Fig. 1).

Hence, if an electron and a proton were to meet squarely at the same place they would annihilate or destroy each other.

When an electron or a proton is in

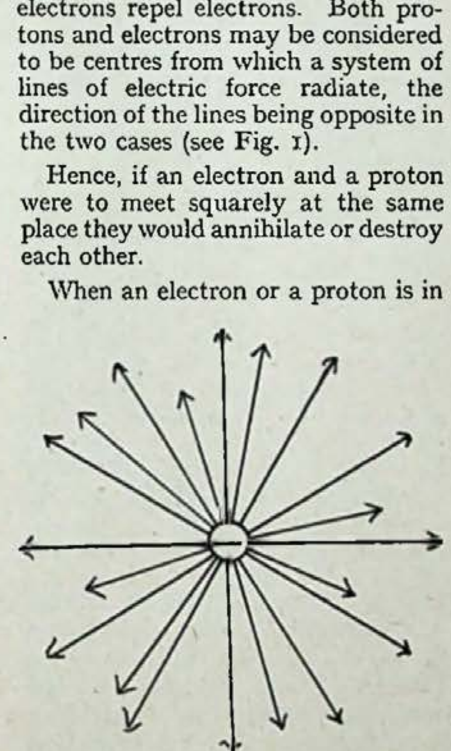


Fig. 1.
Lines of electric force proceeding from an electron at rest. These lines run out in all directions and not merely in one plane as shown in the diagram.

motion, in addition to its system of divergent lines of electric force its path of motion is surrounded or embraced by closed lines of magnetic force, and in its equatorial plane the lines of electric force and magnetic force are at right angles to each other and to the direction of motion (see Fig. 2).

If an electron or a proton is accelerated or is increasing its speed along a straight line, then "kinks" are created in the lines of electric force which fly outwards along the line with a speed of 300,000 kilometres per second, and these moving kinks are accompanied by lines of magnetic force at right angles (see Fig. 3).

This motion of lines of electric force in a direction perpendicular to themselves, accompanied by lines of magnetic force also mutually perpendicular, is called electromagnetic radiation, and it involves the passage of energy through space. This energy is drawn from that of the accelerating electron or proton.

Let us consider, then, the simplest atom, viz., hydrogen gas. The molecule consists of two atoms, each of which comprises a single proton with an electron revolving round it. According to the Newtonian or classical system of dynamics a particle revolving uniformly in a circular orbit is being accelerated because the direction of its motion (though not its linear speed) is continually being changed.

Hence such a revolving electron should radiate electromagnetic energy and in a short time the electron and proton would fall together, and the atom of hydrogen would disappear in a flash of radiation.

Bohr's Hypothesis of Atomic Radiation.

But this does not happen, and an hypothesis to explain the permanence of the atom was suggested by Dr. Niels Bohr, the Danish physicist. He supposes that the planetary electron cannot revolve round the proton at any distance, but only in certain orbits, called permissible orbits, in which it does not radiate; and that the electron only radiates when it jumps or is knocked from an outer orbit into an inner one.

If we imagine a wood board with circular grooves in it, and a marble were pitched on to the board, it would fall into one of the grooves and travel round it. If another marble were pitched at the first and hit it, the latter might be knocked out of one groove into another.

Something of this kind happens in the case of an atom. The space round the nucleus is altered in some way so

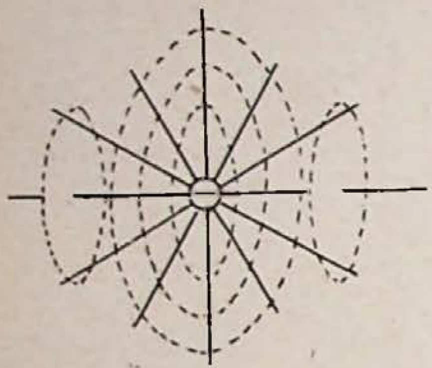


Fig. 2.

An electron in motion has not only radiating electric lines represented by the firm black lines but a system of circular lines of magnetic force represented by the dotted lines. These circles are seen in perspective as oval curves and have their planes perpendicular to the direction of motion of the electron.

that an electron can only revolve round the nucleus in certain orbits spaced apart, but not in any intermediate orbit. The radii of these orbits are proportional to the squares of the natural numbers, viz.: 1, 4, 9, etc. When revolving in an outer orbit the electron has more energy than when revolving in an inner orbit.

Suppose, however, that when revolving in an outer or large orbit some stray electron comes along and knocks it into an inner or smaller orbit, then the energy of the revolving electron is diminished, say, from W to w units.

Bohr's hypothesis is that when the

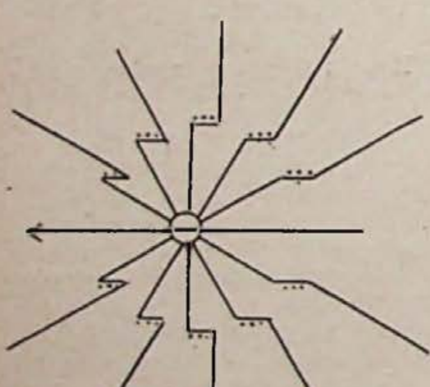


Fig. 3.

An electron jumping forward (to the left). The inertia of the lines of electric force causes a "kink" or bend in the line to occur. These "kinks" fly outward with the speed of light and are accompanied by lines of magnetic force embracing them. The sections of these lines of magnetic force are represented as dots.

electron is revolving in any permissible orbit it does not radiate, but when it is knocked or jumps from a large to a smaller orbit it gives out radiant energy of a frequency n such that $nh=W-w$ where h is a constant of nature equal to $6{\cdot}5 \div 10^{27}$, called Planck's Constant. The electromagnetic radiation which results is not given out in a single pulse, but in a series of pulses coming n times per second, and this wave train is like a short musical sound or note issuing from a horn when it is blown.

Effect of Change of Orbit.

When a free chemical atom such as an atom of hydrogen gas is struck by a wandering electron in such a way as to make its own revolving electron fall from one orbit to another inner one, the radiation given out will have a certain pitch or frequency depending on the two orbits concerned. The atom of hydrogen as well as other atoms may be compared to a bell which, when struck in a certain way, gives out a short musical note of a certain pitch.

When a tube full of rarified hydrogen is subjected to an electric discharge some atoms are giving out one note and others are giving out notes of different pitch. If we analyse this complex radiation by a prism or spectroscope we are able to see the radiations of various frequency separated as "lines" in the spectrum. Some of this radiation is of such a frequency as to affect the eye as light, and these are the visible "lines" or rays.

Others do not affect the eye, but affect a photographic plate or a sensitive instrument of some kind, and are called the ultra-violet or ultra-red lines, according to whether their frequency is greater or less than that of the visible lines.

Result of Orbital Changes.

In the case of the hydrogen atom there are five or six or more permissible orbits. When the orbital electron falls from an outer orbit to the third orbit it produces the ultra-red lines. When it falls into the second orbit it produces the visible lines, and when it falls into the first orbit it produces the ultra-violet lines or rays (see Fig. 5).

Bohr and others have shown that the frequency or number of vibrations per second of the radiation corresponding to each "line" in the spectrum can be calculated from a formula

$$n=B\left(\frac{1}{s^2}-\frac{1}{m^2}\right)$$

where B is a certain constant number and s has the values 1 for the ultra-

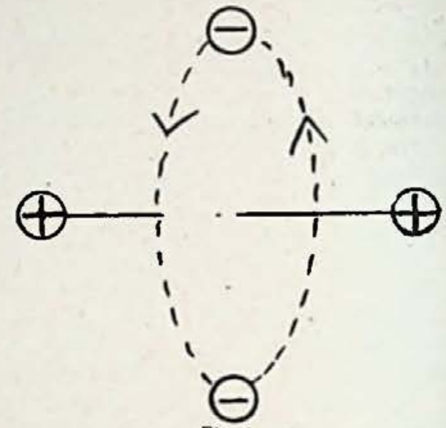


Fig. 4.

A diagram of a molecule of hydrogen. Two negative electrons rotating round two protons. The protons occupy positions at the ends of an axis and the electrons revolve round this axis with the plane of their motion at right angles to the axis.

violet lines, 2 for the visible, and 3 for the ultra-red lines; and m takes various integer values, 2, 3, 4, 5, 6, etc., for the different lines.

Thus the hydrogen spectrum has three visible "lines," red, blue, and violet in colour; and the frequencies of these are respectively 460, 625 and 691 *billion*. (N.B.—A billion in English measure is a million times a million.) These are calculated from the formula

$$n=3289\times10^{12}\left(\frac{1}{4}-\frac{1}{m^2}\right)$$

where m=3, 4, or 5.

It should be noticed that an atom

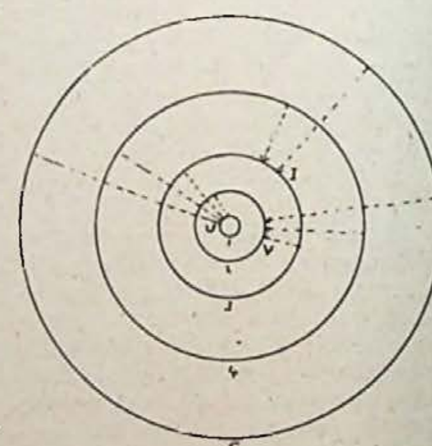


Fig. 5.

A plan of the permissible orbits of a hydrogen atom. When the revolving electron jumps from any orbit to an inner one electro-magnetic radiation is produced.

of a gas cannot radiate unless an orbital electron in it has first been lifted from an inner orbit to an outer one, and then falls back from this outer one into an inner one again, thus producing radiations of definite frequency, or emitting a "line" spectrum.

The reader should understand that the method adopted here of explaining radiation as a kind of vibration transmitted along a line of electric force, just as a jerk or hump can be propagated along a stretched cord, is only one of several different modes of explanation which might be adopted.

The question whether the lines of electric force proceeding out from electrons and protons have a real existence, or are only imaginary lines indicating the direction of electric force, is one which cannot be discussed here. The actuality of these lines, and that vibrations can be transmitted along them is, however, an hypothesis which was suggested by Faraday and has been developed by Sir J. J. Thomson. It has much to be said in its favour as a simple mode of making things intelligible; but on the other hand there are objections to it.

Radiation from Incandescent Solids.

Let us next consider the radiation from atoms of an incandescent solid such as a tungsten filament in an incandescent electric lamp, or the lime cylinder in a lime light.

In a solid substance the atoms are jammed together in nearly close contact, but they vibrate or oscillate when the solid is hot. In this process electrons are detached from atoms with very various velocities and energies.

When a free electron finds its way back into the family circle of an atom which has already lost an orbital electron from one of its outer orbits, the newcomer brings with it a certain amount of energy which may have any value within limits. The new arrival then settles down in an orbit of the ionized atom and the difference between its energy then and before its impact is converted into radiation. Since the impinging electrons are not able to penetrate very far into an ionised atom's private family circle of orbital electrons, the energy available for conversion to radiation is not large; and hence the frequency of that radiation will be small. This implies that the radiation will lie chiefly in the ultra-red part of the spectrum.

Since these impinging electrons may have energy of very various amounts, the emitted radiation will have frequencies which are not definitely separated in amount like those of the spectral lines of a free gas molecule; but the radiation from a solid has frequencies of all kinds over a wide range, and it thus yields a continuous spectrum when the radiation is analysed by a prism.

Line and Continuous Spectra.

Hence, whilst the radiation from a gas which is being subjected to an electric discharge or is otherwise heated is a series of radiations of isolated and different wave-lengths forming a "line" spectrum when viewed through a spectroscope, the radiation from an incandescent solid is, on the other hand, of every possible wave-length within certain limits, and is a continuous spectrum.

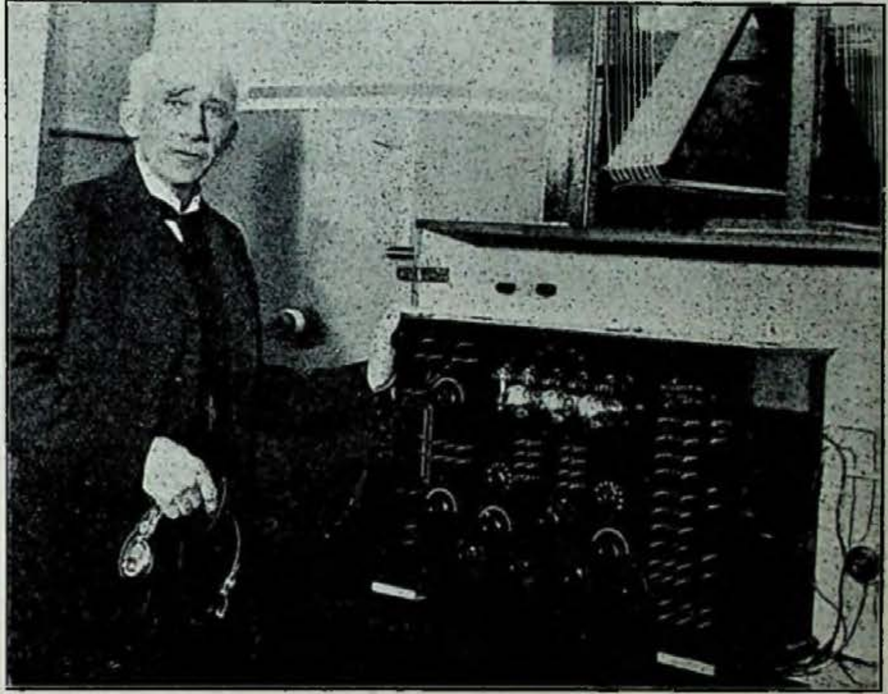
Thus when we look at a straight incandescent filament of tungsten through a prism we see a rainbow-coloured strip of light which forms the visible spectrum. But beyond the red end there is an invisible spectrum of dark radiation; and the same beyond the violet end. The visible radiation is only a small part of the total radiation.

Ultra-red or Dark Radiation.

By far the larger part of the radiation from ordinary sources of light is dark or ultra-red. Thus 90 per cent. of the radiations from an electric arc lamp with carbon electrodes is non-luminous; and so, probably, is 95 per cent. of that of an ordinary incandescent lamp.

The great problem of artificial illumination is to discover a source of "cold light" which yields eye-affecting radiation without the waste involved in the production at the same time of a large amount of dark or infra-red rays which cannot affect the eye.

The radiation from an electric discharge through a rarified gas (as in the neon tubes used for shop advertisement) is more "efficient" in this sense than the ordinary electric lamp, though it yields, as does the mercury arc lamp, a very special "bright-line" radiation far from being equivalent to white light in its power of revealing colours correctly.



Dr. Fleming, the author of this article, who was recently presented with the Faraday Medal by the Institution of Electrical Engineers.

Filtering out Dark Radiation.

These different parts of the total radiation, viz., the infra-red or thermal, the luminous or visible, and the ultra-violet or actinic, can be separated in various ways, as, for instance, by screens.

Thus glass is transparent to the luminous part, but not to the actinic or dark heat. The glass roof of a greenhouse admits the light of the sun, and this, falling on the objects within it, is absorbed and heats them. But the radiation from these objects is infra-red; and this will not pass out through the glass, and therefore the temperature within rises much above that of the outside air.

On the other hand a thin sheet of ebonite is quite opaque to light, but very transparent to dark heat or infra-red rays. Again, quartz is very transparent to ultra-violet radiation up to a certain limit. A solution of iodine in bisulphide of carbon is transparent to dark heat, but opaque to light rays.

Selective Reflection.

There is another method by which infra-red or dark heat-rays can be separated out, viz., by means of repeated reflection from certain surfaces. Certain objects which we call coloured have a selective reflection for luminous rays of a certain wave-length.

Thus a geranium petal is red because when white light composed of a mixture of radiations of very different wave-lengths falls upon it, it reflects only those of that wave-length which affect the eye as red rays and absorbs the rest. If there were no red rays in the incident-light the petal would appear to be black. It does appear black when placed in the green part of a visible spectrum.

In the same way certain materials such as thallium iodide exert a selective reflection on certain wave-lengths of infra-red or dark heat-radiation. If then a beam of complex infra-red radiation is repeatedly reflected from several such surfaces, a ray of a particular wave-length will be weeded out and can be detected as surviving these numerous reflections by its effect on a thermopile.

Also the wave-length of these sifted out ultra-red rays can be measured. By this means it was found possible by Rubens, Nichols, and Wood to filter out from the dark heat radiation of a Welsbach gas mantle or other source invisible rays the wave-length of which was as much as 1/75th of an inch, that is, about 500 times the wave-length of the extreme red rays in the visible spectrum, or 9 octaves below it in a musical sense of the word.

Dark Heat and Electromagnetic Radiation.

The eminent British physicist Clerk Maxwell predicted in 1865 the possibility of producing electromagnetic radiation, and that light was of this character; but it was not until 1887 that the German physicist Hertz succeeded in actually producing such radiation. Little by little the methods were found of producing this electromagnetic radiation of ever-increasing and also continually decreasing wave-length and all intermediate wave-lengths.

Nichols and Tear succeeded in 1923 in producing electromagnetic radiation with a wave-length of only 1/100th of an inch, whilst wave-lengths up to 50,000 feet are in use in wireless telegraphy in the large all-round stations.

We have thus succeeded in producing by purely electrical methods Hertzian waves which are shorter than the longest of the ultra-red rays in a gas lamp. There is therefore no gap in the continuous spectrum of electromagnetic radiations extending from the longest wireless waves to the short ultra-violet or actinic rays; and little or no gap between these and the X and gamma rays which are given out by electric discharge or by radium and radio-active substances. Of all this vast gamut of radiation extending over 50 or 60 octaves the human eye is sensitive only to one little octave of it as visible light.

Noctovision.

These ultra-red invisible rays have only recently been put to practical use by Mr. J. L. Baird in his very important noctovision experiments, and for other purposes in secret signalling. They can be reflected and concentrated in a beam just like light-rays, and converged to a focus by ebonite or thin glass lenses, and by means of certain devices they can be converted back again into luminous rays or into electric currents.

The means by which this detection is done must, however, be reserved for later articles.

The Spider and the Elephant.

By "Ruminator."

WHY are spiders not as big as elephants? Consider the Spider.

In the spider we have a most wonderful creature. It has six legs, and it can run with a fleetness which is dazzling to watch. It can run along the face of a wall. It can run across a ceiling. It can suspend itself from on high at the end of a gossamer thread of its own manufacture. Out of the same gossamer thread it can weave itself a wondrous web the pattern of which is without rival among the multitudinous creations of Nature.

The spider's web is more than a thing of beauty. It is a very practical structure, for it will bear the weight of its weaver and ensnare the insects upon which it battens.

Consider the spider at rest in the centre of his web. For hours he moves not, but he is ever on the alert. Let an unwary insect become enmeshed in the clinging web and, like a shot out of a gun, the spider darts out from his resting place and descends upon his victim.

Such a wondrous creature is the spider. Why are spiders not as big as elephants? Why should not a creature so enormous as an elephant be produced by Nature after the same design as the spider?

The reason is not far to seek. It is contained in the Law of Similar Structures, which states that, for structures made of a given material, *the weight increases as the cube of the linear dimensions.*

It requires but little imagination to appreciate the fact that legs designed like those of a spider would prove utterly incapable of supporting the huge bulk of a body the size of an elephant's.

What has all this to do with television?

Just this: Those who would perform really profitable experiments with a view to establishing a principle or proving a theory may easily obtain misleading results and draw false conclusions from observations made on the performance of small scale models.

In other words, build your models full size.

FOR THE EXPERIMENTER

By Our Technical Staff

IN the past issues of this Magazine we have described a simple form of television apparatus and one capable of transmitting images and shadows between two separate machines.

In the present issue we propose to digress a little, and before describing positive elements in television apparatus, to give our readers an opportunity of carrying out some simple experiments in the use of invisible rays. The successful application of the invisible rays known as the infra-red has enabled vision in total darkness to be achieved.

At the British Association meeting in Leeds last year persons seated in total darkness were seen on a screen in another room as if they had been brilliantly illuminated. In the opinion of many experts noctovision holds forth greater potentialities than does television, the power to see in the dark and to see through fog opening up immense commercial possibilities.

Infra-Red Ray Experiments.

The apparatus used by Mr. Baird is beyond the scope of the ordinary amateur, but in this article we will show how to construct apparatus with which it will be possible to demonstrate the existence of these rays and to use them for carrying out most interesting experiments. In later issues we hope to develop this subject and open the pathway to a field of research offering the most fruitful possibilities.

The apparatus required for the experiments described here does not entail any expenditure, with the exception of the purchase of a sheet of very thin ebonite. This sheet of ebonite is used as filter. Ebonite possesses the property of passing the infra-red rays while completely absorbing all visible light. An ordinary 100-watt lamp is fixed in a little box, the front of which is covered with a sheet of thin ebonite—·019 inch or even thinner ebonite is quite suitable. The arrangement of the box and lamp is shown in Fig. 1. About one yard away from this box is placed an interrupter disc, as used in the simple televisor apparatus described in our first issue. Behind the light interrupter is placed an ordinary selenium cell, connected to a two- or three-valve amplifier and to a pair of headphones.

If now the light interrupter is started up and the headphones attached to the amplifier a loud humming will be heard, due to the infra-red rays falling upon the selenium cell after being interrupted by the revolving disc. This humming sound is stopped immediately a hand is interposed between the infra-red radiation and the cell, proving that the note is caused by the infra-red rays.

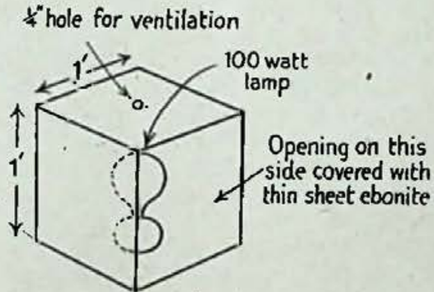


Fig. 1.
A simple form of infra-red ray generator. Instead of a wooden box, a biscuit tin can be used if desired.

These infra-red rays can be focussed and dealt with in the same way as ordinary light, and if a lens is arranged to focus an image of the lamp on to the cell before the screen of ebonite is interposed and the ebonite is then placed in position the note will be heard with almost undiminished vigour.

A further most interesting and instructive experiment is performed by making a little case of thin ebonite or gelatine. As shown in Fig. 2, this little box is filled with thick smoke, and although the smoke appears quite opaque to the eye it will be found that the infra-red rays will penetrate it and still affect the selenium cell.

Try Ultra-Violet Rays.

Instead of using ebonite the same experiments may be duplicated, using the ultra-violet rays instead of the infra-red. The ultra-violet rays require a different form of screen to the infra-red, and this ultra-violet screen may be obtained from Messrs. Chance Bros. for quite a small sum. It resembles a piece of intensely blue glass and is quite opaque to visible light. If interposed in place of the ebonite it will be found that the cell is still affected and the experiments carried out using the ebonite aperture can be duplicated using Chance glass, only in this case fog is not penetrated. By increasing the power of the amplifier it is remarkable over what distances this interrupted light (or rather these interrupted rays) can be detected, and many modifications of the apparatus will no doubt suggest themselves to the investigator.

We hope in a future issue to give an account of other experiments of these rays. In our next issue we are, however, reverting to television again, and will describe a further form of a home televisor, opening up another field of investigation.

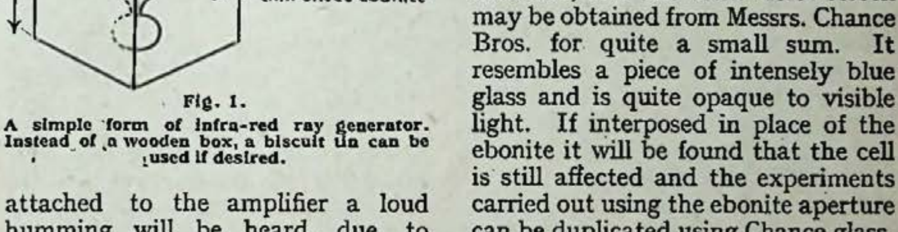


Fig. 2.
Rough sketch of the arrangement for carrying out experiments to demonstrate the fog and smoke penetrating capacity of infra-red rays.

Natural Vision and Television.

Part II.—Visual Radiations and Experiments.

By J. DARBYSHIRE MONTEATH.

NATURAL vision reaches its highest perfection with the human eye as the end organ of sight.

Originating with the lowest organisms as pigment cells, nerve-connected, we trace the growth of the eye with the higher organisms who have collected cells and nerve-fibres attached to refractive substances. Some worms have pigment cells near the brain. Star fish have a nerve going to a crystalline organ at the arm tips.

A skin protects the eye of certain fish; the crocodile has eyelids, and birds possess both eyelids and a developed organ of vision. Monkeys' eyes are nearly human, as they have an intensified centre of sensitivity in the retina known as the *mascula lutea*, or the yellow spot.

And so it appears that nerve elements develop, and even transfer their functions by slow progressive steps to bring about changes in the brain to secure not only binocular vision but enhanced sensitivity and consciousness of sight, according to the urge and the adaptation of the creature.

In the human eye this yellowish elevated spot is about one millimetre in diameter, having a tiny depression in the centre that is not yellow, called the *fovea centralis*. It is in the centre of the retina and situated so as to be free from blood vessels.

Here the layers are thinned and sensitivity is more acute than at any other part of the retina. The cones here are each separately connected to a neuron chain, whereas in other parts of the retina, cones and rods are connected in groups. It is this separate connection of the cones that permits of observation of details, and the fine distinction of colour, aided by an advanced mechanism accommodation which sharpens the focus.

Accommodation and Noctovision.

We exercise this faculty of accommodation when we demand that the eye shall view near objects; when we relax, the eye restfully focuses the more distant scene. This power of accommodation varies with age, and is found to be at its best in youth, and ceases almost altogether in old age.

During the demonstrations of noctovision at the period of the meetings of the British Association at Leeds, it was noticeable that elderly people had more difficulty in observing the image received than younger people, who immediately recognised their friends who sat in darkness at the transmitter.

The field of view for normal vision is about 150° horizontally and 120° vertically, but for the *fovea centralis*, sighting details, only about the area of a finger-nail at arm's length.

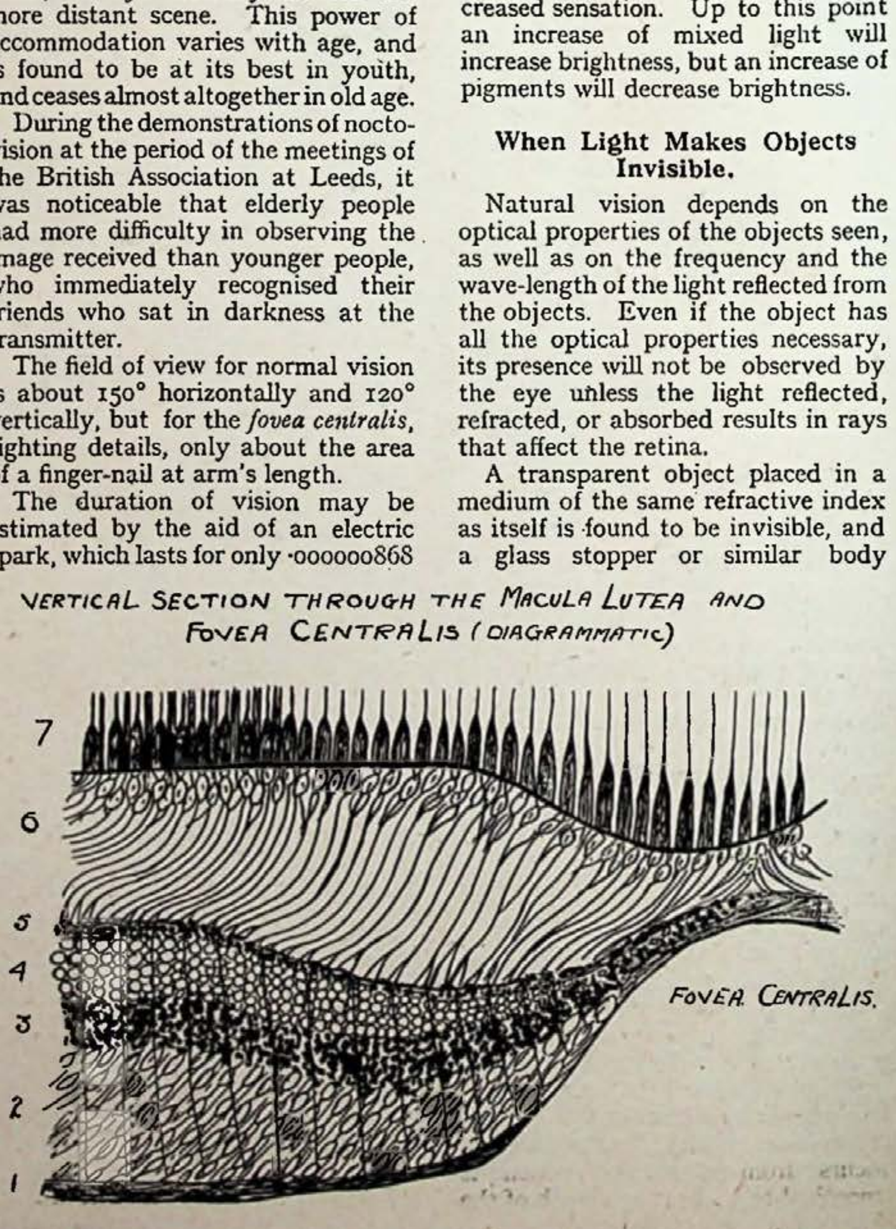
The duration of vision may be estimated by the aid of an electric spark, which lasts for only ·000000868 of a second, yet can be observed. The interval necessary to see things separately is found to be ·027 of a second. When the height of sensibility is reached further increase of light or colour produces no increased sensation. Up to this point an increase of mixed light will increase brightness, but an increase of pigments will decrease brightness.

When Light Makes Objects Invisible.

Natural vision depends on the optical properties of the objects seen, as well as on the frequency and the wave-length of the light reflected from the objects. Even if the object has all the optical properties necessary, its presence will not be observed by the eye unless the light reflected, refracted, or absorbed results in rays that affect the retina.

A transparent object placed in a medium of the same refractive index as itself is found to be invisible, and a glass stopper or similar body

VERTICAL SECTION THROUGH THE MACULA LUTEA AND FOVEA CENTRALIS (DIAGRAMMATIC)



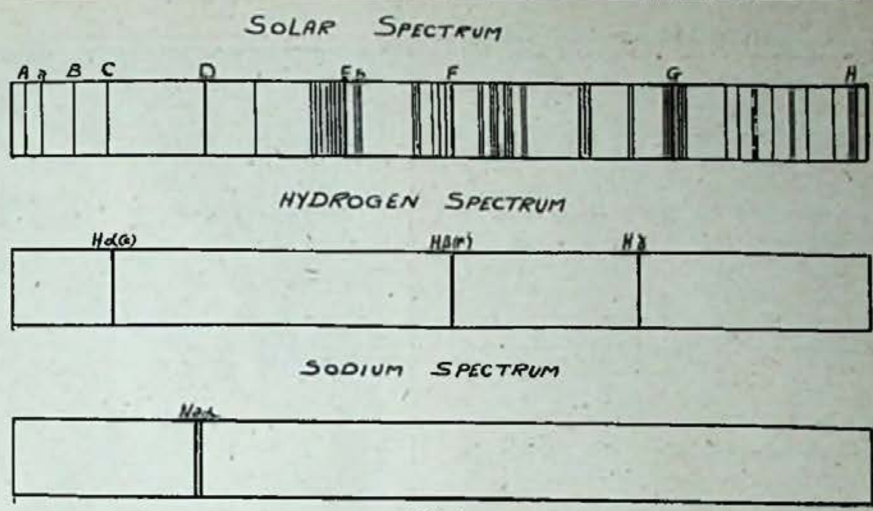


Fig. 1.
Solar, hydrogen and sodium spectra.

placed in the centre of a self-luminous chamber, if looked at through a peep-hole, remains quite unseen because neither refraction, reflection, nor absorption can be evidenced to the eye owing to its position in relation to the light acting upon it.

Such a chamber is easily constructed by means of Balmain's phosphorescent paint and a carefully constructed globular box, having a peep hole.

Artistic Vision and Television.

To the eye of an artist most bodies give rise to a sense of colour and beauty, for his discerning eye summates the reflected and refracted rays and takes into account the impinging tinge of local colour that affects the aspect and tone of the object.

It is this achievement of televising the light, shades, and tones of the features, by setting up impulses on his light-sensitive device proportional to the varied light from all parts of a face, that emphasises Mr. Baird's system of television, and few who have seen even noctovision have failed to remark on the extraordinary human appearance of the image.

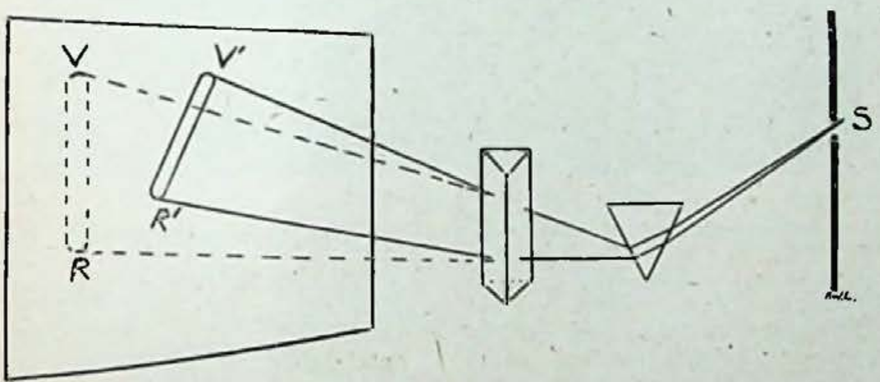


Fig. 2.
Exploring the spectrum of a beam of light by means of two prisms.

Only a very small percentage of the light received is reflected from a face, or ordinary object, into the televisor. Much of the light may be generally scattered, and its wave-length changed; for all phase relations on the wave front of the received light are destroyed by an unpolished surface.

Reflecting Power.

A highly polished surface will reflect three-quarters of the incident light; really regular reflection only occurs from a surface which is smoothed to within one-eighth of the wave-length of the incident beam.

The reflecting power varies with different materials and depends on the angle at which the light is reflected. A matt surface of lamp-black will copiously reflect light at a grazing angle of reflection. Bright sodium has the highest reflecting power known, the calculated figure according to Drude being as high as 99·7 per cent.

Selective Reflection.

Objects may selectively reflect light from the incident beam. Gold reflects red light more strongly than green light, and according to the wave-length of the received light the reflecting power will vary. Silver reflects, when highly polished, 95 per cent. at one wave-length, and as low as only 4·2 per cent. at a shorter wave-length of incident light.

Wave-Length and Reflecting Power.

Wave-length of light.	540 μμ	600 μμ	700 μμ	
Silver..	90.5	92.6	94.6	In per cent. reflecting power.
Nickel	59	65	69	
Copper	37	72	83	
Gold	33	84	92	
Silver glass mirror ..	79–85	81–88	84–89	
Mercury glass mirror	73	70	73	

The Visual Spectrum.

By allowing light to enter a dark room through a very narrow chink or slit, many historic experiment-may be repeated and very entertains ing facts may be demonstrated.

If the air of the room is free from moisture or dust the beam of light will be invisible, for it is the reflections from fine particles that give evidence

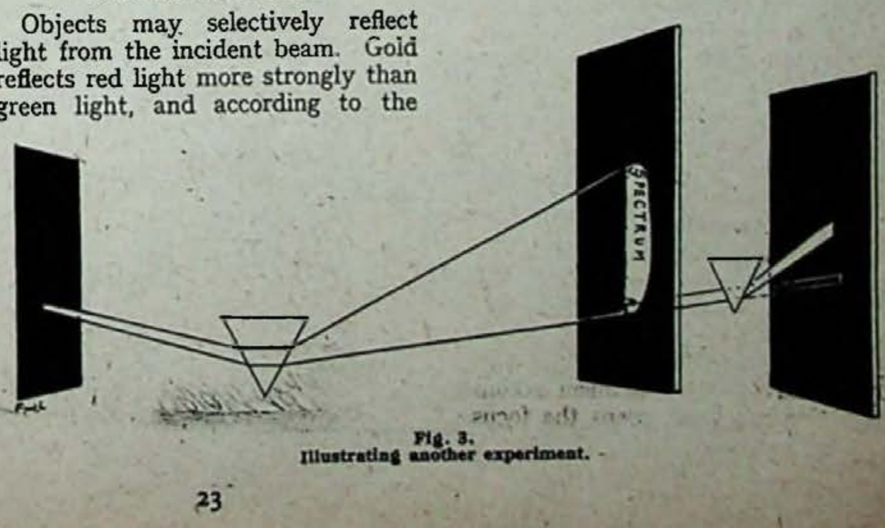


Fig. 3.
Illustrating another experiment.

of the beam, and for the same reason the surface of a perfectly smooth mirror would be unseen.

Obtain a prism, as found in old-fashioned chandeliers, and produce a spectrum by catching the refracted rays on a sheet of white cardboard. Carefully observe the colours, and it will be seen that the yellow part is brightest; near the D line being actually the brightest part. Compare the spectrum obtained with the diagram of the solar spectrum and note the lettering which aids in mapping out a spectrum. See Fig. 1 (Solar Spectrum).

Generally speaking the retina is more sensitive to light between C and F, the maximum effect being obtained between the wave-lengths D and E, which the eye recognises as yellow light. Newton experimented with the spectrum and found that each ray consisted of monochromatic light, that is, light whose colour is unchanged by being further passed through a prism or medium; though there is no such thing as real monochromatic light.

Fig. 2 illustrates the effect of adding a further prism, and Fig. 3 shows how a simple ray may be tested by making a hole in the screen and examining the ray by another prism.

Fig. 4 shows the increased dispersion by adding to the number of prisms. Five prisms suitably arranged make a direct vision spectroscope, and Fig. 5 shows the plan view of the laboratory spectroscope or spectrometer. Fig. 1 illustrates the sodium spectrum which gives monochromatic light. The wave-length of a monochromatic beam varies as the beam passes through one transparent body to another and is proportional to the velocity of the colour of light in the particular material or medium, so the wave length of yellow light is shorter in glass than in air, because light travels more slowly in glass than in air.

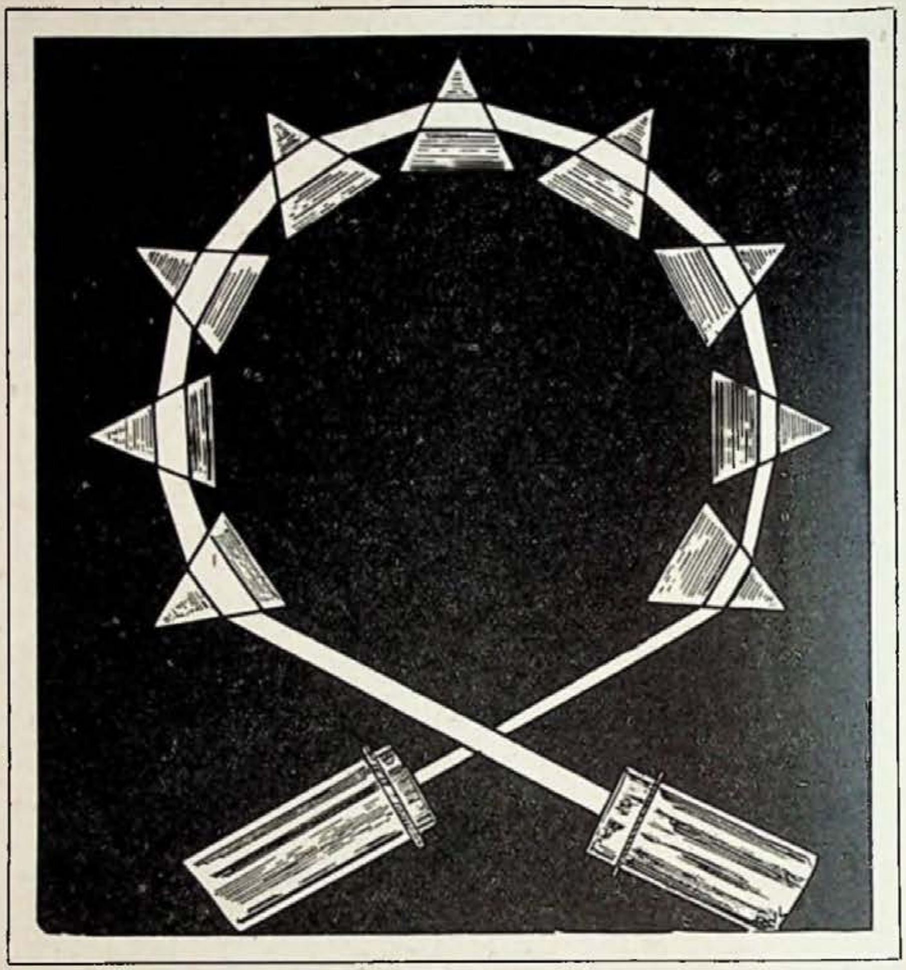


Fig. 4.
Showing the dispersion of a beam of light by means of a series of prisms.

$$\frac{\text{Velocity of light}}{\text{Wave-length of light}} = \text{Frequency or number of vibrations of light}$$

and the index of refraction varies with the colour of the light.

More Dark Room Experiments.

Use a lens, and focus a slit, then place a prism in the beam and so secure a more pure spectrum. Now intercept the light, by a coloured transparent body, glass or gelatine, or a coloured solution, and observe an absorption spectrum. Burn a strip of magnesium ribbon, as a source of light, instead of using the slit by sunlight, and observe the bright line spectra. Compare the lines with the hydrogen spectrum (Fig. 1).

Place in a test-tube some paraffin oil or quinine solution and explore the region beyond the violet end of the spectrum and observe fluorescence of the liquid. Or, similarly, use a candle, or wax, or select from the various bodies that exhibit fluorescence in ultra-violet light. These latter experiments will be more effective if the luminous rays are cut off by covering the slit with a piece of violet glass.

The bending of light round the edge of a razor blade should be observed. This bending of light into its shadows is referred to as the diffraction of light. Remove the prism and lens, screen off the rays for safety, hold the razor blade in the beam and sight across its edge, and light will be seen on the edge away from the light

(Continued on page 33.)

Fig. 5.
A plan view of a laboratory spectroscope or spectrometer.

LIGHT-SENSITIVE CELLS

The Liquid Type

By H. WOLFSON

THE light-sensitive cell, in one form or another, is the most important part of a television transmitter. The selenium cell is totally inadequate for the purpose, and even the potassium type of photo-electric cell does not conform to the stringent requirements of practical television. The purpose of the present article is to bring to the notice of readers a new type of cell, as yet very little developed, but which has, nevertheless, considerable possibilities.

The cell in question is of the type first discovered by Becquerel, in which two metal plates are placed in a glass cell containing a liquid (the nature of which I shall discuss in detail a little later), which, when illuminated, gives rise to a small photo-electric current.

An Experimental Cell.

The effect has been observed in the following manner. Two copper plates (thin foil as used for fixed condensers) are thoroughly cleaned by immersing in a strong solution of caustic potash, and then washed under running water for some time to remove all traces of the potash, after which they are immersed in a very dilute solution of copper sulphate, made by dissolving 0·2 grams of crystallized copper sulphate in 1000 cubic centimetres of water. These are allowed to stand in the daylight (sunlight if possible) for eight days, after which time the plates will have become coated with a thin, bluish coloured film, which chemical analysis has shown to be cuprous oxide. If now the cell be so arranged that one copper plate can be illuminated while the other is in the dark, it is found that a very small current will flow while the plate is exposed to the light, and will cease with the extinguishing of the light.

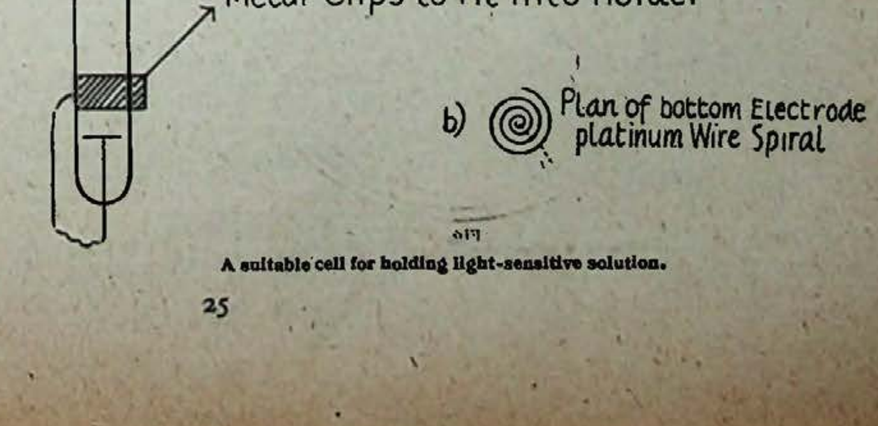
This elementary experiment was improved upon by the American experimenter, Case, who proceeded as follows.

Copper electrodes of size 4·4 cm. by 23 cm. long and thickness about 0·02 cm. were placed in a solution made by dissolving 6·25 grm. of pure crystallized copper formate in water and adding to the solution so obtained 0·5 per cent. of 80 per cent. formic acid. The plates were, of course, cleaned in the usual manner and polished with steel wool before immersion. Photo-electric effects were clearly shown when this cell was illuminated. It is not, however, my intention to go into details in connection with this early work, as much of it was unsuccessful in obtaining any definite results with other copper salts, or in fact with others which were tried.

The next important step was made by Baur, in Switzerland, in an important series of researches with uranium compounds. The Becquerel effect is shown by a number of inorganic salts. As a result of the Becquerel effect one experiences a change of electrode potentials, which are brought about in certain solutions by exposure to light.

In every case this change is reversible; it disappears again in the dark, reappearing with the switching on of the light, while the solution, by repeated changes from dark to light, undergoes a perceptible change. It has been shown by a number of people (Scholl, Goldmann and Brodsky, and Samsonow) that this is only a type of Hallwachs effect such as is shown by the potassium cell; that under the effect of light the light-sensitive molecules give off free electrons, which are collected by the electrodes. Baur thinks that the primary reaction in a photo-chemical modifying change of the light-sensitive substance occurs, and that these form material new compounds of their oxidation and reduction products.

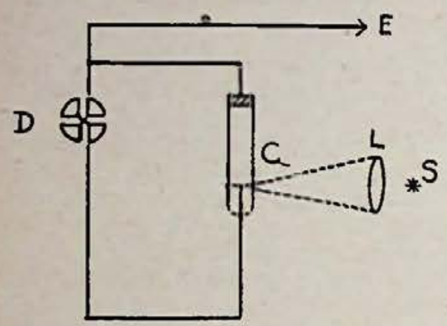
These discussions are shown to be correct in a new degree, for by a continuation of his studies Baur has confirmed his hypothesis. After the photolysis of uranyl formate had been demonstrated, and it had been shown that a complete analogy existed between the existing photo-chemical and the observed electro-chemical delayed action of uranyl compounds, Baur decided that the



A suitable cell for holding light-sensitive solution.

primary action of light is to transform the light-sensitive substance into a higher or lower state of oxidation.

Stated in his own words, "The molecule of a chemical light-sensitive substance appears, therefore, by the absorption of light to undergo a



Arrangement for illumination of cell, and detection of photo-electric current. C, cell shown in previous diagram; D, Dolazalek Electrometer; E, Earth; L and S Lens and Lamp.

form of electric polarisation, through which an outward operating potential difference results. This appears to be the primary photo-chemical change, and all photolysis and Becquerel effects are derived from it."

This brings us to the question of the Becquerel effect in dyestuffs. If Baur's view of the primary photo-chemical change occurs, the molecule of the light-sensitive substance loses one of its electrons through the absorption of a quantum of energy, and thus a potential difference exists between the positive nucleus and the lost valency electron, whose maximum value is limited by the magnitude of the absorbed quantum, so that the primary photo-chemical change can be represented by the equation:

$$E + h\nu = E^{\oplus}_{\ominus}$$

where E stands for the receiver of the light quantum hν, and the symbol on the right-hand side of the equation indicates the condition of the light, that is, the condition of photo-chemical polarity.

Going back to our example of the uranyl compounds, how can we explain the Becquerel effect on these grounds? In uranyl sulphate the effect develops by the presence of U^{IV} ions or of oxalate ions, etc. In this case the appropriate photolysis can be written thus:

$$U^{VI} \begin{cases} \oplus\oplus + U^{IV} = U^{IV} \\ \ominus\ominus + 2H^{\cdot} = H_2 \end{cases}$$

If we have undisturbed photolysis of a hydrogen-oxygen mixture (in the proportion 2 : 1 as in the electrolytic gas from water) and an electrode at the hydrogen potential, the photolytic oxygen will be depolarised, thus bringing about the positive effect. If, on the other hand, there is an oxygen electrode, the photolytic hydrogen becomes depolarised, and we then have a negative effect.

The results of a large number of experiments with solutions of dyes and of quinine sulphate are of the greatest interest, in that they show us the possibilities of improving and using such an arrangement, which is the essence of simplicity and cheapness, in place of selenium or other types of cells which are characterised by their time lag inefficiency or initial high cost.

Experimental Solutions.

The following are the most important of the substances used by Staechelin in his researches, which were conducted in the laboratory of E. Baur:—

(1) Quinine sulphate, in the presence of a *little* sulphuric acid.
(2) Rhodamine B.
(3) Rhodamine 3B.
(4) Tetrachlorfluorescein.
(5) Sodium salt of Eosin.
(6) Phosphin, a mixture of hydrochlorides of chrysanilin and crysotoluidine.
(7) Amido G. salt. 2.6.8. sodium naphthylamine disulphonate.
(8) Amido G. salt 2.5.7.
(9) Resorufin. an oxazine dye.

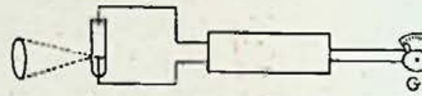
In order that the reader may realise the order of magnitude of the photo-electric current generated by this type of cell, I give below a selection of typical results obtained by Staechelin.

Solution N°.		Dark P.D. Millivolts.	Light P.D. Millivolts.
(1) 0·5 per cent. rhodamine B.	(IV.)	265	267
(2) 0·5 per cent. rhodamine B.	(V.)	294	320
(3) 60 c.c. above + 5 c.c. 3·5 N potassium chloride.	(I.B)	223	240
(4) 60 c.c. above + 40 c.c. 3·5 N potassium chloride.	(III.)	244	319
(5) 96 per cent. alcoholic soln. rhodamine B.	(VI.)	200	317
(6) 60 c.c. 0·5 per cent. rhod. B. + 20 c.c. acetaldehyde	(II.B)	178	229
(7) 100 c.c. 0·5 per cent. rhod. B. + 3 c.c. M/5 oxalic acid	(V.)	422	412
(8) 100 c.c. 0·5 per cent. rhod. B. + 3 c.c. M/5 oxalic acid	(VI.)	412	402
(9) 100 c.c. 0·5 per cent. rhod. B. + 10 c.c. M/5 oxalic acid	(V.)	396	407
(10) 2·5 grm. quinine sulphate in 250 c.c. water + 25 c.c. M/I sulphuric acid	(II.B)	474	448
(11) 80 c.c. 10 per cent. quinine soln. + 40 c.c. vanadium dioxide in sulphuric acid	(I.B)	453	485
(12) 20 c.c. 10 per cent. quinine soln. 20 c.c. 40 per cent. formalin	(III.B)	189	250

Experiments with alcohol, acetaldehyde, ferrous and ferric sulphate, ammonium oxalate, hydroquinone, potassium chloride, hydrochloric acid, etc., added to the quinine showed mainly a drop in potential on illumination, due to increase in resistance.

(13) 0·5 per cent. resorufin	(IV.B)	270	243
(14) 90 c.c. + 10 c.c. picric acid solution	(I.)	474	414
(15) 90 c.c. + 3·5 mol. potassium chloride	(III.B)	172	201
(16) 100 c.c. + 50 c.c. formalin	(IV.B)	126	146
(17) 50 c.c. + 50 c.c. M/10 ammonium oxalate	(V.)	165	134

Electrodes are denoted by the figures in brackets and are of size (I.)–(VI.) 300–400 sq. mm., (I.B)–(VI.B) 800–1,200 sq. mm.



Alternative arrangement using valve amplifier and sensitive millivoltmeter or galvanometer.

I have for some time been carrying out experiments with a new type of photo-electric cell, which should, from theoretical considerations, give a much more sensitive response to slight variations of light such as are experienced in a television transmitter.

This is also a liquid type of photo-electric cell, and contains a colloidal solution, the nature of which I shall give, together with a description of the apparatus employed, in a later article, so that the ardent television experimenter can investigate these phenomena for himself, with little trouble or expense.

In view of the recent deal which the Baird Company has made with a powerful American group, the following remarks by "Candide" in the *Sunday Pictorial* of May 13th are of interest:—

"TELEVISION PROSPECTS.—Such rapid advances have been made, I learn, in perfecting the apparatus for television that in the near future the possibilities of enjoying the invention will be brought down to the individual 'listener-in.' It is a pity that in this country so many detractors can be found for a purely British invention. If the inventor were a foreigner there would be nothing but praise. We have yet as a nation to learn the valuable lesson of encouraging our own inventors."

Television—A Prognostication

By HAROLD APPLETON

TELEVISION! How the very sight or sound of that name conjures up in our minds a vast multitude of facts and fancies. We visualise the opening up of new fields to conquer in a search after fame: or, perhaps on somewhat less ambitious lines, but nevertheless equally as important, a satiation of one's desire to become thoroughly conversant with a subject which bids fair to alter the whole aspect of our everyday life, just as wireless broadcasting did a few years ago.

Television may be one of the youngest of the applied sciences, but it shows every promise of outstripping its rivals in the capturing of the public fancy. Critics may criticise; but their scepticism is born generally from a sheer inability to lift their thoughts from the commonplace, and time will explode their pessimism so that perforce they will be compelled to eat their own words. 'Twas ever thus with new and epoch-making inventions, and history continues to repeat itself.

Quite apart from the fact that the position which television will occupy amongst the amenities of mechanical and electrical civilisation will involve the need of men of high calibre and sound technical education, there is something very subtle about television which cannot fail to make its appeal to everyone, old and young alike. The three preceding numbers of this journal have provided sufficient material to bring about the initiation stage, and this will gradually foster a desire to go still deeper into the subject.

The fascination of this new wonder then cannot fail to become all absorbing; and imbued with the spirit of experimenting, hundreds, nay thousands, will inscribe their names on the roll of "television fans," and thus form a living antithesis to the scorn and the carping attitude of cynics.

A Peep into the Future.

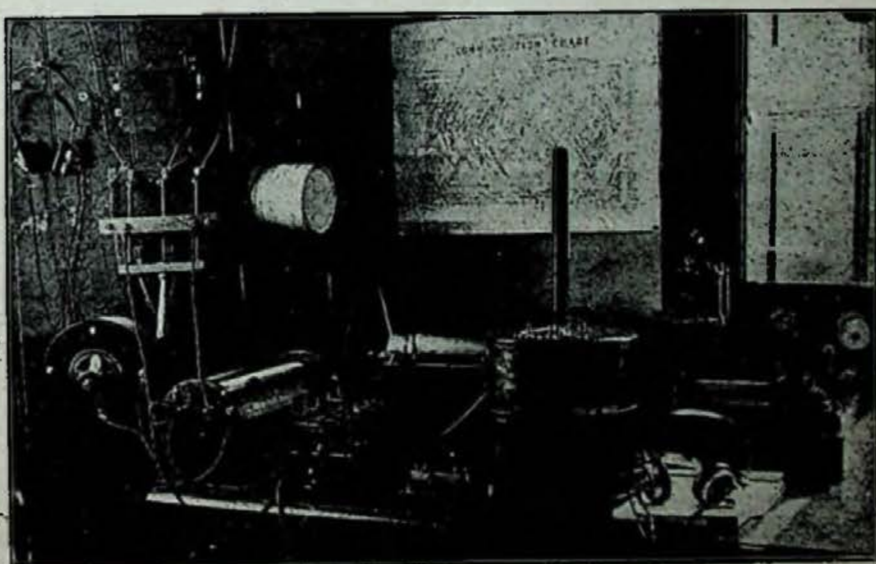
My interest in this subject being known, I am frequently accosted by friends or written to by correspondents who ask me to give my opinion as to what the future holds for television; so, enjoying to the full the comfort of an easy-chair by the glowing embers of a warm fire, and listening to the soft strains of a first-rate orchestra through the medium of a high-class wireless receiver, I decided to assume the rôle of prognosticator and set down my thoughts and conclusions for others to read, mark, learn and inwardly digest.

As far as wireless receiving sets are concerned, they have been developed to such a high degree of efficiency that any radical or really intrinsic alteration in design may not be expected to take place for some time to come. It is the same with allied industries or developments. A stage is reached when numerous refinements become the vogue, a process which is all to the good and which has its reward in the improved performance of the apparatus or machinery, and a reduction to the barest minimum of the controls to be handled; but this obviously savours of nothing epoch-making.

That being the case, and while specially designed Televisors will be marketed exclusively for receiving the television transmissions, it is well within the realms of possibility that a device may eventually become available to the public which can be attached to the existing home receiving set in much the same manner as are present-day accessories, say for example, the loudspeaker. The popularity of such an arrangement cannot be overestimated, and while such a prediction may, at first sight, savour of the incongruous, a moment's reflection will prove that such is not altogether the case.

Analagous Reasoning.

If one is the possessor of a wireless receiving set which incorporates reliable components, and, on the low-frequency side, is designed to give the nearest approach to "straight line amplification," then with a good-class cone or moving coil loudspeaker, the various individual instru-



FOURTEEN YEARS AGO.

This is what a typical amateur wireless enthusiast's installation looked like in 1914. The receiving equipment (at front of table) is but little different from that which was used by listeners-in when broadcasting first started. What will the first Television sets look like?

ments of an orchestra can be distinguished with ease. The bass notes of the drum and the shrill renderings of the piccolo, although broadcast simultaneously, do not interfere with each other but can be picked out quite readily.

If that is the case, can we not picture on analagous lines (while admitting that the analogy is not wholly adequate to convey a full impression of what is at the back of my mind) that while a broadcasting station is, say, transmitting a song or speech we shall not only be able to recreate everything that is imparted to the microphone, but the "atmosphere" of the studio will also be imparted to the item by making visible to us the face or movements of the person broadcasting, through the medium of an allied transmission on the same wavelength?

This is no flight of imagination, but the outcome of logical reasoning. Turn for a moment to the acoustical frequency range, and we find that the band of frequencies actually covered is relatively narrow; and while it is debatable as to what is the frequency limit of response of the human ear, since this varies with individuals, we are safe in saying that there is no response to frequencies a little over 20,000 vibrations per second. This being so, the existing carrier wave (i.e. the medium which "carries" sound effects converted into electrical effects from the studio to your own fireside, reconversion then taking place in the wireless receiving set) will possibly have impressed upon it the Television impulses.

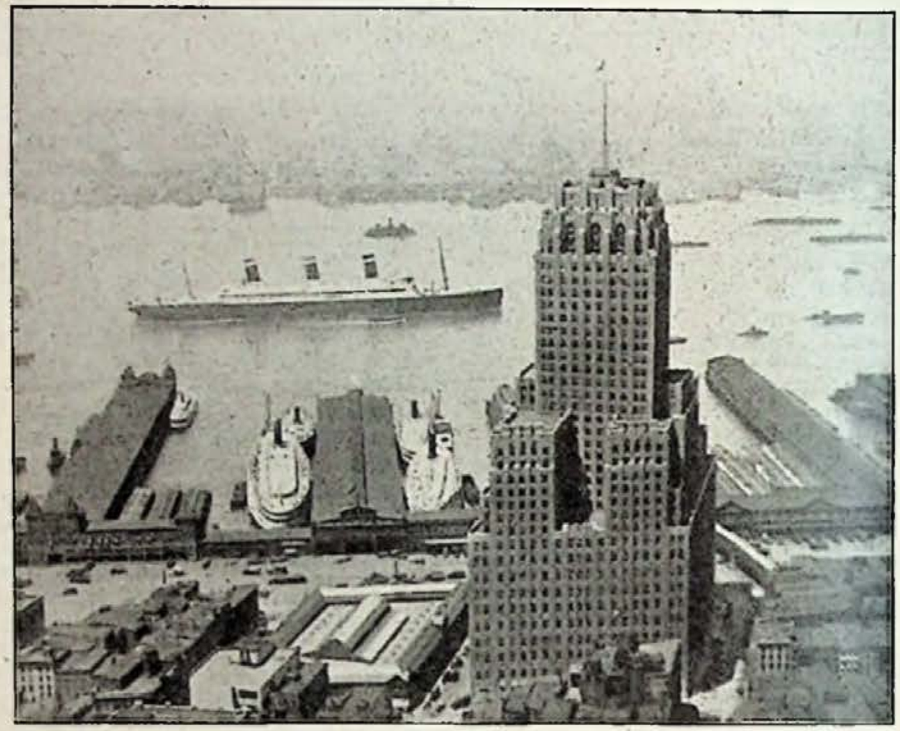
These impulses, being above the audible range, will not affect the loud-speaker, but will be separated at the receiving end and filtered through the attachment and thus produce the picture required. The sound and picture broadcast will not be mixed in the true sense of the term, and in consequence interferences will not occur.

The alliance between broadcasting and television will probably not develop exactly along these lines at first. One must learn to walk before one can run; and the first combined sound and television broadcasting experiments will probably be made through the medium of two separate broadcasting stations, operating on different wavelengths, one for sound broadcasting, and one for television broadcasting. This, of course, will necessitate the use of two separate receivers.

From inside information one can say quite confidently that television is nearer to the public reach than most people imagine. The scientific minds of all the civilised countries are concentrating on its perfection, and while initially it would be unfair to expect any perfected service it is, to put it mildly, unwise to ridicule, for pioneers are above that sort of thing. Did not the early investigators of wireless transmission and reception meet with the same opposition, and where do we stand to-day as far as that science is concerned? The sapling growth of 1900 is, in 1928, a well-rooted tree of enormous dimensions, and it will be the same with television.

The name of John L. Baird stands out pre-eminent in this country for his wonderful progress in a relatively short space of time. Research and experimenting have successfully coped with the early sluggish action of the first selenium cells, and no surprise need be evinced if the complete and final apparatus evolved is not on simple lines comparable with existing broadcast receivers. Not content with black and white transmission, attention will be turned later to colour transmission.

Do not run away with the idea that television is a form of cinematograph or motion-picture arrangement. That is quite erroneous. It is actually seeing by telegraphy (either with or without wires) an instantaneous vision of actual living scenes at the moment they are taking place, not a "bottling up" of incidents to be thrown on a screen as occasion demands.



WHERE TELEVISION BROADCASTING CAN NOW BE RECEIVED.
A view of New York from the top of the Woolworth Building.
(Photo. by courtesy of U.S. Lines.)

Ruminating still further, we can picture the time when attachments will be made to the ordinary telephones so that subscribers can see one another as well as hear each other's voices. But there, one must not let imagination run too far ahead of logical advance, although this may even be excused if we realise how much has been accomplished in recent years.

Television has emerged from the laboratory stage into a far-reaching accomplishment, as witness the London to Glasgow demonstration and the more recent trans-Atlantic and *Berengaria* transmissions; and readers of this journal can look forward with anticipation to further developments which will prove conclusively that television is with us in every sense of the word, and not something apart from our normal everyday existence.

GLIMPSES INTO THE FUTURE No. 3

A Mid-Atlantic Drama

by R. Heath Bradley

"HALLO . . . Yes . . . Yes, this is Brandon speaking . . . Who ? . . . Seymour ? . . Bill Seymour ? . . . By all that's wonderful. . . . Thought you were still in South America. . . . Yes, rather. . . . Where ? . . . Savoy ? . . . Of course I will. . . . One o'clock ? . . . Yes, suit me fine. . . . Right, cheerio till then."

Brandon, seated in his office, hung up the receiver, smiling to himself. He liked Seymour, liked him very much, and always welcomed the rare occasions when he came back to England. Seymour was a roamer. Possessed of ample means, he was never so happy as when he was seeking adventure in parts of the world which, to most people, were merely names to be found in small type in a gazetteer.

This last journey had kept him away from England for over four years. But Brandon found him looking much the same as usual, rather more deeply tanned, perhaps, and possessed of a greater number of the fine wrinkles round the eyes which tell of life in sun-scorched countries . . . and as reticent as ever. Brandon knew him too well to ask for details of his adventures ; he knew he would hear of them only if and when Seymour chose to tell him.

Consequently, as the two men sat at lunch, Brandon confined his side of the conversation to general topics whilst Seymour asked for news of mutual friends. He had made no plans for the immediate future and, being a bachelor with no permanent home, was very happy to accept Brandon's invitation to stay with him at his delightful home near Reading.

A Television Experiment.

The two journeyed down to Reading together in the evening and, after dinner, settled comfortably in Brandon's cosy library. Presently the latter rose, switched on his wireless set and, after a few minutes critical listening, turned to Seymour with the remark :

"That's better quality than we used to get when you were last home, isn't it ? "

"It's wonderful," Seymour replied. "I'll have to get you to tell me all the latest developments. I'm afraid my wireless knowledge has got a bit rusty. What's the other outfit by its side ? "

Something New.

"Ah, yes, that'll be new to you," Brandon said. "That's my television set. Television has made great strides lately and it's wonderful how clear the scenes are getting. There's nothing on at the moment, but it so happens that the Television Broadcasting Company is undertaking a rather ambitious experiment tomorrow. They're hoping to show us the Lord Mayor's Show and are fitting up a televisor near Ludgate Circus. You'll be able to see what it's like—unless you'd rather see the actual procession ? "

"No, thanks," Seymour answered him. "I suppose it will be much the same as ever ? The usual procession of 'Ancient and Honourables,' eh ? "

Brandon laughed. "Yes, that's about it. All the same, it'll be rather interesting to see it by television. Wish I could stay at home and see it, but business won't permit, so I'll show you how to operate the set."

Conversation drifted on to other topics and it was late before they retired for the night.

Just after Brandon returned from lunch on the following day Seymour rang him up from Reading. He had seen the Lord Mayor's Show ; it had come through quite well on the television set. He had seen the procession and a portion of the crowd. It was the latter which had proved of the greatest interest to him because he believed he had seen someone he particularly wished to meet. Would there be films of it at any cinemas that evening ?

A Surprise for Seymour.

Brandon, after facetiously asking whether it was a case of "cherchez la femme," and being assured that it was a man in whom Seymour was interested, promised to find out where the film was being shown, and book seats.

That evening they sat together, in a London cinema, taking but little interest in the thrilling love drama which was being shown. But when the News Gazette was announced on the screen, Seymour leaned forward eagerly. Various episodes and leading features of the Lord Mayor's Show appeared, and then, for a minute or so, a view of the procession as it passed up Ludgate Hill. Seymour suddenly gripped Brandon's arm :

"Do you see that man standing on the kerb, on the left ? There, by that small boy with the flag . . . Short, thick-set man, with a wide-brimmed hat. . . . See him ? . . . That's Seth Watson, sure enough. Let's get out of here and I'll tell you about him."

An Old Enemy.

Seymour's interest in the film was over. He had seen all he wanted to see, and led the way out into Regent Street. As he came out into the light Brandon saw that his eyes blazed angrily.

"One would almost imagine you didn't like your friend Watson," Brandon remarked dryly.

"Like him ! " exclaimed Seymour. "Would you like him if he'd shot you in the back and left you for dead? Like him! For eight months I was on his trail with the intention of shooting him on sight . . . and I'll get him, too, some day."

"And what do you propose doing now?" asked Brandon. "We're not in South America, remember, and if you start shooting people, you'll get on the wrong side of the police very quickly."

"Oh, don't you worry," replied Seymour. "I'm not going to run the risk of being accused of murder on account of a cur like Seth. But I'd like to scare him back to where he belongs so that I could follow him and settle our little account. Let's go somewhere and have some supper and I'll tell you what happened."

Seymour's Story.

As so often happens in such affairs, "there was a woman in the case." The woman was, as Seymour said, the nearest approach to the typical heroine in a cow-boy film that he had ever seen, and, appropriately enough, she was the daughter of the man who owned the one and only "hotel" in the small township where he, Seymour, had stayed for a time whilst in America.

Seymour was a bachelor (rumour had it that there was once a girl . . . but that does not concern this story), but he was a good-looking man with a charming manner, and this girl, Anne, took a fancy to him. What ultimately made matters worse, she was insatiably curious concerning life in the big cities and would willingly listen for hours on end, in rapt silence, if Seymour would only tell her about London, New York, and other places he had visited in his travels. This he was quite willing to do. He was at the "hotel" for a rest after a touch of fever and time hung rather heavily. And besides, though he took no particular interest in Anne, she was pleasant enough to talk to . . . and he would have had to be a virulent misogynist not to be secretly flattered at having a pretty girl always eager for his company.

Seth Watson's Jealousy.

Seth Watson lived in that town, too, and Seth looked upon Anne as his property. Anne liked him . . . liked him enough to be quick to notice his jealousy, and to play on it, as women will, by displaying even greater interest in Seymour. And Seymour, seeing how matters were shaping and remaining entirely heart-whole, was amused, but omitted to be on his guard.

Consequently the day came when Seth "had it out" with Anne, told her he had finished with her, and rode away from the town. But, just as he mounted his horse, Seymour emerged from the "hotel." Watson, seeing the man he hated, turned swiftly and shot him, leaving him, as he thought, dead.

His anger fortunately spoiled his aim, and when Seymour recovered he spent months trying to trace Watson. But the search proved unsuccessful, and Seymour eventually decided to return home, with the score still remaining to be settled.

That was the tale Seymour told, and the sight of his old enemy had renewed his determination to meet him. Was he staying in London, and if so, where? Brandon's opinion was that a private detective was their only hope, and he promised to find the name of one early next day.

A Difficult Task.

The following morning Brandon was able to introduce to Seymour a young detective who had already gained a reputation for solving difficult problems, and to him Seymour outlined his reasons for wishing to trace the whereabouts of Seth Watson, without, of course, letting that hot-tempered gentleman know that anyone was on his trail. Seymour took the detective along to the cinema, pointed out the man he had seen in the film, and then left the problem in his capable hands.

Nine days passed, and on each morning of those nine days, the detective 'phoned, only to report "no luck." But on the tenth day a long-distance call came through to Brandon's house. The detective had traced Watson at last. He did not call himself Watson; but the detective was confident that he had "got his man," who was, that very day, sailing for America on the *Boronmatric*, under the name of Benson. The detective had been near him as he went on board, and had been able to see details of his features which, when described to Seymour, made it certain that the man calling himself Benson was most certainly Seth Watson.

One of the public rooms on the "Leviathan." This may be the room selected to accommodate the television equipment which it is planned shortly to instal on the liner.
(Photo. by courtesy of U.S. Lines.)

There was not sufficient time for Seymour to catch the *Boronmatric* before it sailed, but the new trans-Atlantic service of giant airships was in regular operation, and he found that, by leaving three days later, he could still be in America in time to meet Watson.

For a long while that evening Seymour sat lost in thought. Brandon, seated near his wireless set, searching for distant stations, knew better than to disturb him. Presently his patience was rewarded, and Seymour came out of his reverie with a chuckle.

Televising to Mid-Atlantic.

"Do you think the *Boronmatric* would have a television set on board ?"

"Almost sure to . . . yes, I remember it has," Brandon replied.

"And are private transmissions permitted ?"

"Not through the Television Broadcasting Company, of course. But there are many amateur transmitters. As a matter of fact," Brandon continued, "I know one. Fellow named Lloyd. Lives at Croydon. He's got a very fine set and specialises in long-distance transmissions."

"Do you think," asked Seymour, "that you could persuade him to transmit to the *Boronmatric* ?"

"Yes, I expect he would be willing. But what's the idea ?"

Seymour chuckled. "I've remembered," he said, "a little trick of mine which Seth also knows quite well. Whenever I'm about to use a revolver I have a habit of screwing up one eye tightly and just showing the tip of my tongue out of one corner of my mouth." He laughed. "I'm supposed to be rather a good shot and very 'quick on the draw,' as they say in America ; and one day, when a few of us were indulging in a little revolver practice—it was before Seth began to get jealous of me—he noticed my habit and then, after inspecting my target, said : 'Wal, I guess I wouldn't like to see you do that trick with your face if I was in front of you !' He thinks I'm dead ; and if he *could* see me 'do that trick with my face,' I don't think he would be very far from dropping dead with fright."

"And you're thinking of letting him see it by television ?" Brandon asked.

"It'd be a bit of a joke if he could," remarked Seymour, grimly.

A Unique Experiment.

When the suggestion was made by 'phone to Brandon's friend Lloyd, he was quite willing to attempt the television transmission, but suggested that it would be necessary first to communicate with the *Boronmatric* in order to ensure that Watson would be "looking-in" at the appropriate time. Later in the evening he 'phoned again and made a suggestion which immediately appealed to Brandon and Seymour.

Next morning Seymour consulted the passenger list of the *Boronmatric* and found in it the names of a number of prominent people. By judicious enquiries he obtained the names of some of their relatives and intimate friends, and called upon them with the suggestion that, as a unique experiment, they might care to let those on the *Boronmatric* see and hear

(*Photo* : Underwood and Underwood.)
Mr. D. McFarlan Moore, Inventor of the Moore Tube, who has done much to develop special neon tubes for television work.

"the friends they left behind them." Television was still sufficiently a novelty to cause the suggestion to be greeted with enthusiasm, so that about twenty people crowded, that evening, into the small room at Croydon, where Mr. Lloyd's television and broadcast sets were installed.

At the appropriate hour the *Boronmatric*, which had previously been asked to participate in the experiment, signalled that everything was ready. One by one the people assembled at Croydon took their places in front of the television set and microphone.

In Mid-Atlantic.

Of what took place on the *Boronmatric* that evening, Brandon and Seymour received an account later. Neither could have anticipated, when making their plans, how dramatic the situation would become.

One by one a name was called, and a passenger took his or her place before the small television screen. On it appeared the face of the friend in England, the lips moving in unison with the words of greeting which emanated from the loud-speaker.

After a time the name of Benson was called. Benson (or Watson, as we know him) started with surprise, amazed that anyone in England should be calling him. His name had to be called several times before he eventually came forward and, almost reluctantly, took his place before the television screen.

Then those crowding behind Benson saw a face appear on the screen. They saw also that Benson leaned forward suddenly, muttering a startled oath. The eyes of the face on the screen seemed to look straight into Benson's. Then, slowly, one eye was screwed up tight and the tip of the tongue appeared at the corner of the mouth

From the loud speaker came in quiet, measured tones, a voice which Watson thought was long silenced :

"Hallo, Seth Watson ! Can you see me ? This is Bill Seymour calling you . . . not dead as you thought, but very much alive, Seth Watson. Alive and ready to meet you . . ."

Uproar.

The rest of the sentence was drowned in a crash, as Watson drove his clenched fist at the television screen ! Immediately all was uproar ; but from the back of the crowd a man came forward with a purposeful air. Reaching Watson he grasped his shoulder and swung him around.

"Seth Watson, eh ?" he said. "I had my suspicions. We want you in New York on a number of counts" ; and he had the handcuffs on Watson before he had recovered from his shocked surprise.

. . . .

Seymour never had the opportunity of settling his account with Watson. That gentleman, after his affair with Seymour, had "gone bad" and started a life of crime. But so effectively had he covered his tracks that he felt perfectly safe in returning to America after his trip to England.

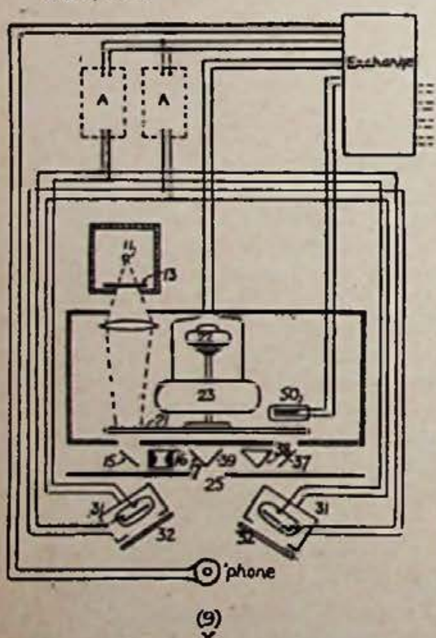
And it is quite possible that he would have eluded detection and the long sentence which he ultimately served but for Seymour's "little television joke."

Invention and Development

The following abstracts are prepared, with the permission of the Controller of H.M. Stationery Office, from specifications obtainable at the Patent Office, 25, Southampton Buildings, W.C. 2. Price 1s. each.

No. 286262.—Dr. H. E. Ives and Electrical Research Products seek provisional protection for a two-way television system, which it is claimed may be used in conjunction with the ordinary telephone system and work through an Exchange. The object (9) is irradiated with invisible radiation in order that he may not be dazzled, and light-sensitive cells selective to such radiation may be employed at the transmitters.

286,262

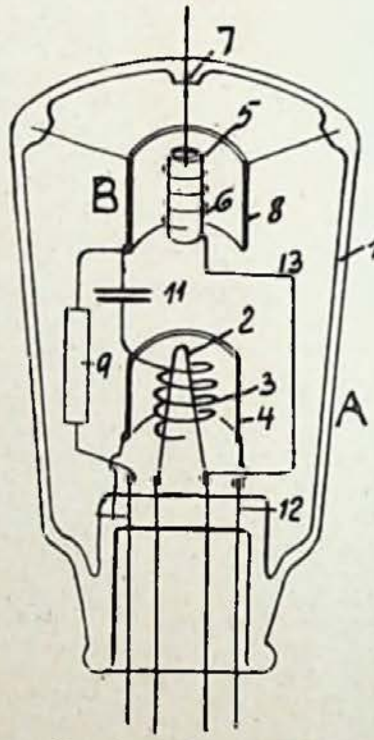


(9)
X

An exploring beam of ultra-violet and infra-red rays from the source (11) passes through the screen (13), the scanning disc (21), an optical system (15) (16) (17), and one-half of an aperture (25); the screen (13) serving to filter out the visible part of the spectrum. The radiation is diffusely reflected from the face of the subscriber (9), through further filter screens (32) (32), on to pairs or groups of cells (31) (31), of which each pair may comprise one photo-electric cell sensitive to ultra-violet radiation and one thalo-sulphide cell sensitive to infra-red radiation. The relative effects of the two kinds of cell can be adjusted to give the right tonal value to the picture. The output of the cells after amplification at (A) is sent to line.

Incoming signals are applied to the neon lamp (50) and the resulting variable illumination is built up by the scanning disc (21) and the optical system (37) (38) (39) so as to be visible through the remaining half of the aperture (25). The scanning disc is of special design, being provided with two diametrically opposite spirals of holes so that received and transmitted signals pass at the same instant through diametrically opposite holes. The disc is driven by a motor (22) synchronised by an A.C. generator (23).

One of the problems met with in television is that of magnifying the extremely small currents liberated by light-sensitive cells. The photo-electric valve amplifier, which is the subject of a recent patent (No. 261391) by Dr. Siegmund Loewe, employs an incandescent cathode for the final stages of amplification (A), and one or more "cold" photo-electrically active sources of emission for the preceding prior stages (B), with a consequent saving of filament heating current. At least two of these stages are mounted in a common vacuum. The illustration shows a multiple unit valve containing two separate sets of electrodes,



the cold cathode being a cylinder (5) whose surface is coated with a photo-electric substance (sulphide of thallium, a hydride of potassium or selenium or rubidium are suggested). Its photo-electric energy is mainly due to the light or heat radiated from the lower filament (2), which reaches it by reflection from all parts of the inner glass wall (1) and by using a perforated anode (8). The electron emission from the upper cathode may also be assisted by a direct metallic connection (13). Inter-valve coupling consists of a special high-resistance element (9) and a blocking condenser (11).

The valve may be used as either a high- or low-frequency amplifier. In

(Continued on opposite page.)

(*Concluded from page* 24.)

which has bent below the edge, which light consists mostly of long wave-lengths.

Cut a slit in a visiting card, by gashing it with a sharp penknife, and view the light through this fine slit. Then observe the fringes due to diffraction; or note the colours of cigarette smoke, which arise from the same cause. Lycopodium dust gives a fine effect.

Chromatic Aberration.

Colours due to the lens will have been observed when the lens was used to focus the slit, for the violet rays as they enter and leave the lens will be more bent in the direction of the axis of the lens than the red rays. Thus the violet rays are brought to a focus at a position nearer the lens than the red rays. Catch the colour on the screen and you will see a central violet spot, and around it a red ring, but on moving the screen a little further away a central red spot will appear surrounded by a violet ring.

Achromatism.

To correct for the colouration of the image produced by a lens, special lenses are designed so that the red and blue rays meet at the focus of the yellow rays. The lens is then said to be achromatic, and has the same effect for different wave-lengths of light.

For photography a compromise is made so that the visual rays and the actinic rays are focussed on the ground glass of the camera. This is effected by uniting the D and F lines of the spectrum by two lenses, not far from G, say G′ 434$\mu\mu$.

Secondary Spectrum.

When achromatism is obtained for two colours there is still an uncorrected residual dispersion, called the secondary spectrum, which is annoying to users of optical instruments, though it is relatively unimportant, as achromatism for two colours is sufficient for most practical purposes. It is, however, necessary to correct for the secondary spectrum in the object-glass of the microscope, and for lenses used for colour photography, where three images taken through light filters must be exactly superimposed on each other.

With modern lenses this higher refinement of achromatism is possible, and such lenses are apochromatic.

In telephotography actinic achromatism is desirable, and the two colours, F 486$\mu\mu$ and violet 405 $\mu\mu$ of the mercury vapour spectrum are brought to a focus as near as possible to G′, which is the maximum active part of the spectrum.

APPARATUS RECEIVED.

Messrs. the Wet H.T. Battery Company have sent for review an example of the "Standard" Sac Leclanche Low-Tension Battery. As its description implies, this battery is of the wet Leclanche type and offers an extremely efficient source of current where it is not possible to charge accumulators at home. The main advantage of this type of cell is that little if any attention is required to maintain it in good order. Even after a very long period of constant use renovation is both simple and economical. With this type of cell re-charging is not necessary in the usual accepted sense. An occasional renewal of sacs, zincs, or electrolyte does a job which in the case of the accumulator recurs all too often.

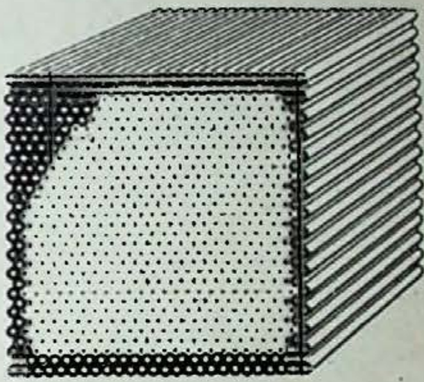
The cells are constructed from an earthenware container which carries within it a heavy cylindrical zinc and sac element. These are parts which it is only necessary to replace after a long life. Two such cells may be purchased complete in awoodenfcase and with the electroltye chemical at £1 6s. 6d. Each cell is rated at 1½ volts with a maximum current output of .25 amps. Providing the current consumed does not exceed this figure we are of the opinion that this battery would prove very satisfactory in use.

Another production of this Company is the "Standard" Sac Leclanche Battery for H.T. supply. This model follows the same design as the L.T. battery already mentioned in that it consists of a glass container carrying sac and zinc. It is manufactured in three sizes of cells: No. 1, up to a maximum current drain of 7 m.a.; No. 2, up to 14 m.a.; and No. 3, up to 30 m.a. This particular battery has been on the market for some years and we understand that there are over 2,000,000 cells in use. As in the case of the L.T. type, spares for the H.T. model are also obtainable.

Readers interested in these batteries are able to obtain descriptive literature from the manufacturers at 12–13, Brownlow Street, High Holborn, London, W.C. 1.

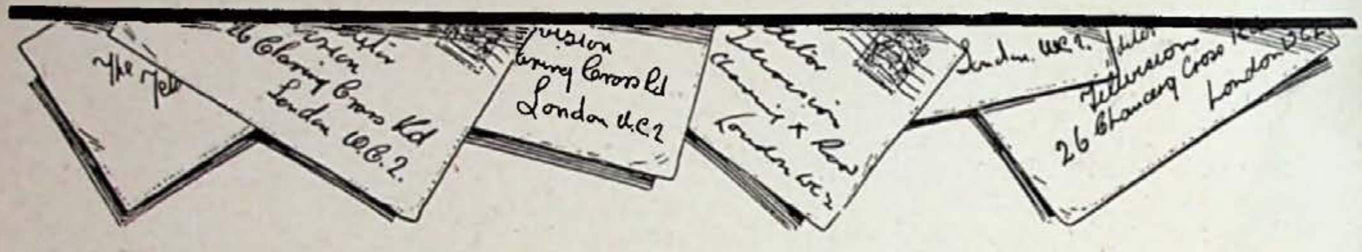
(*Concluded from opposite page.*)

operation, incoming signals are applied between the grid lead (7) and the filament. These currents control the system (5) (6) (8). Alternating voltages are thus transmitted through the condenser (11) to the lower grid (3).



A method of producing images without lenses is referred to by J. L. Baird in Patent No. 285738. The illustration shows a screen made out of a bank of closely-assembled tubes in the form of a honeycomb. By placing a ground glass screen at the back of such a bank of tubes an image appears on it of any object placed in front, due to the fact that the individual light rays in passing longitudinally through the tubes are not spread laterally. When the tubes are arranged parallel with one another the image will be of the same linear dimensions as the object, but magnification or diminution of the image can be obtained by using a slightly diverging or converging arrangement of the tubes. The inner surface of the tubes may be of a non-reflecting nature so as to avoid any dispersion of the light by internal reflection, or the tubes may be in the form of thin rods of glass quartz or other transparent material.

THE BEST LETTERS OF THE MONTH



The Editor does not hold himself responsible for the opinions of his correspondents. Correspondence should be addressed to the Editor, TELEVISION, 26, *Charing Cross Road, W.C.* 2, *and must be accompanied by the writer's name and address.*

SUGGESTIONS FOR EXPERIMENTERS.

1, NEW COURT,
ST. JOHN'S COLLEGE,
CAMBRIDGE.

May 2nd, 1928.

THE EDITOR,
"TELEVISION."

DEAR SIR,

I have found your present number of TELEVISION very interesting, and was extremely struck by your article on selenium. As it was well pointed out, it appears that selenium can exist in a number of allotropic and crystallographic forms, in a very similar manner to sulphur. This seemed to me to lead towards the solution of the selenium lag problem. In a text-book I found the following statement: "This effect (the phenomenon of electrical resistance varying with exposure to light) was attributed by Siemens (1835) to the existence of two forms of metallic selenium, one a good conductor of electricity and formed from the other on exposure to light. These two forms have been isolated. Form A consists of round granular crystals stable at 140° C., and an insulator in the dark. Form B, which is produced when form A is heated to 200° C. for some time, or is exposed to light, forms longer crystals and is a conductor (Marc, 1903, and Reis, 1908). The action is chiefly produced by red rays."

Surely if this is the case the selenium lag is due to the conversion of the one form into the other; hence it ought not to be a matter of very great difficulty to experiment with the one form and determine what suitable catalyst will convert it into the other. And so if all conditions are adjusted for this molecular re-arrangement to take place as quickly as possible, the lag ought to be reduced to a negligible quantity.

This explanation seemed so simple that it hardly seemed worth the while putting down on paper. But, as I have not seen anything printed anywhere to that effect, it seemed to me it just might be worth while making the suggestion, since one does not wish to leave any stone unturned. I feel certain that as soon as the cause of the lag is fully comprehended, the lag will be reduced to a negligible quantity.

Yours faithfully,
C. M. ADCOCK.

[*We shall be interested to learn the results of any research work which readers may care to undertake along these lines.*—EDITOR.]

RIANT-MONT, LA ROSIAZ,
LAUSANNE, SWITZERLAND.

May 10th, 1928.

THE EDITOR,
"TELEVISION."

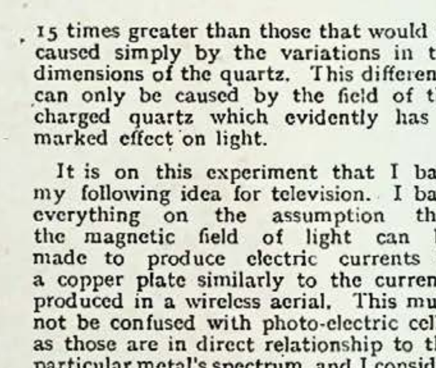
DEAR SIR,

I have been a wireless experimenter for a long time and have even from time to time peeped into its mathematical depths. The more knowledge I acquire the more wireless interests me, and I have always had a great ambition to examine all phenomenon from theoretical points of view. Television has been of particular interest to me, and the other day an entirely new method for televising suggested itself to me. I have had no opportunity of experimenting in the new line, and so do simply suggest it to you as perhaps a method which may be of interest to you.

The theory is based on the electromagnetic property of light, and I would first describe the experiment which led me to my new idea. The experiment is a well-known one in crystallography which deals with the piezo-electric properties of the well-known quartz crystal. Pressure in certain directions provokes electric charges on the two extremities of the crystal, and similarly when an electric charge is furnished to a crystal of quartz, it undergoes certain deformations as regards its dimensions.

The figures of interference of quartz between two nickels at right angles, using polarised light, are well known, as well as the deformations of the rings which take place when the thickness of the quartz is artificially increased or decreased. When examining a quartz crystal under similar conditions, but which has been changed exteriorly, and therefore its dimensions are altered, it is found that the deformations of the figures of interference are from 10 to 15 times greater than those that would be caused simply by the variations in the dimensions of the quartz. This difference can only be caused by the field of the charged quartz which evidently has a marked effect on light.

It is on this experiment that I base my following idea for television. I base everything on the assumption that the magnetic field of light can be made to produce electric currents in a copper plate similarly to the currents produced in a wireless aerial. This must not be confused with photo-electric cells, as those are in direct relationship to the particular metal's spectrum, and I consider quite a different phenomenon using a metal of high conductivity. From the experiment with the quartz crystal it is evident that an electric field has an effect on light, and the reciprocal is no doubt true also. I feel that, when once the right method is chosen, light immaterially of its wave-length would be able to induce electric currents in a wire, coil, or metal plate; similarly to those produced by wireless waves. It is in my mind quite probable that this actually does take place, only the frequency being so great, and the intensity probably so



small, it is with the known instruments impossible to detect such currents.

However, if a means could be determined how these small currents might be heterodyned or superimposed on to a wave of lower frequency some very interesting experiments ought to be able to be made. Now, on the presumption that these light waves have been harnessed after the manner above described, or in a similar appropriate way the question comes: How are they to be applied to television? Of course it is desirable to be able to televise, besides people in studios; important events, boat races, etc. Before description the above is the hypothetical diagram of the broadcasting instrument.

Light waves coming from any object are projected by means of a lens on to a copper plate. Some form of oscillation or modulation is used, and thence the superimposed oscillations are amplified, after which they would be broadcasted in any of the conventional ways. A stroboscopic effect might be tried provided a suitable frequency can be obtained. The next question that arises is how these signals are going to be reconverted into light at the receiving station. A really satisfactory solution would require a more careful and deeper study of the nature of light, its means of propagation, and various other electrical and mechanical phenomenon.

Nevertheless I believe that a solution will be found, and I suggest as a basis of experimenting the following vague idea. At the receiving station the waves would be duly received, amplified and detected. It is evident that the rectified current would consist of a direct current with superimposed currents proportional to the currents in the first copper plate; for it will be observed that the so-called intermediate frequency is really only a modulated frequency. The rectified current variations would be applied through a condenser to a copper plate and form a lantern, a beam of light would be sent on the plate.

The copper plate would become the seat of secondary rays vibrating in resonance with those from the source (the copper plate in this case would have to consist of a very fine wire gauze to make it the seat of the phenomenon known as diffraction). The varying currents in the plate would tend to oppose or help the fields caused by the sources of light, and the secondary rays would reach maxima and minima. Then, on the other side of the wire mesh the image would be visible.

Of course I have presumed that the currents in the copper plate and copper mesh are strictly proportional, which may not be the case. If realisable such a method would include the broadcasting of lantern slides, cinematographs, outdoor events, and probably in their natural colours.

Finally, I here send you not a solution to television, but an encouragement to people to try television on an entirely different experimental basis. I think that a solution is to be found apart from the mechanical and synchronising systems. The solution is probably to be found in the electro-magnetic property of light.

If you find this letter not too absurd, and if you consider it deserves inclusion in your television journal by all means do so; and I shall be much obliged for any information you can let me have as regards my new idea.

Yours faithfully,
E. P. ADCOCK.

[*We shall be glad to open our columns to correspondents who may care to discuss this suggestion.*—EDITOR.]

THE TELEVISION SOCIETY DEMONSTRATION.

23, CARSON ROAD,
DULWICH, S.E.1.
May 11th, 1928.

THE EDITOR,
"TELEVISION."

DEAR SIR,

At the last meeting of the Television Society, held on May 1st, I had an opportunity of seeing for the first time Mr. Baird's television apparatus in action. The demonstration was given, I believe, under exceptionally difficult conditions—a small transmitting aerial and what must have been a veritable ethereal tempest with its storm centre at the 2LO station a mile away.

The Hon. Sec. of the Engineers' Club, Mr. Dimant, was sitting in front of the apparatus at the transmitting end. The picture seen was not steady, neither were the transmitting flashes sufficiently rapid to produce a continuous uniformity of illumination, but in spite of these defects the features of the secretary were clearly recognisable, and the general illumination of the picture surprisingly strong—a matter upon which I had been sceptical before seeing the transmission.

Many years ago I saw an early experiment in the projection of moving pictures. In this case, too, the pictures were not steady and the frequency with which they were thrown on the screen was obviously not sufficient; but these defects were quickly overcome and the kinematograph became a great commercial success. I think it is highly probable that television projecting apparatus will develop on similar lines. In principle the present apparatus appears to be sound, so that commercial success may very conceivably be achieved by a careful tuning-up of its elements.

Yours faithfully,
PROF. F. J. CHESHIRE.
C.B.E., A.R.C.S., F.I.P.

LIVE INTEREST IN SOUTH AFRICA.

WHITE HEATH,
MARTINDALE,
SOUTH AFRICA.
April 13th, 1928.

THE EDITOR,
"TELEVISION."

DEAR SIR,

The March number of your new publication, "TELEVISION," has been sent out to me by a friend. I think it is THE thing we experimenters have been waiting for, something dealing with the commercial development of television, and at the same time covering the construction of simple apparatus. I have been a wireless experimenter for some years, and wish to take up television.

Wishing you every success in your pioneer enterprise, and assuring you that S.A. is "awake."

Yours faithfully,
J. G. SPRIGG.

Radio FO—A8B, S.A.R.R.L.

TELEVISION SOCIETY.

MEMBERSHIP APPLICATION FORM.

June, 1928.

Please send me particulars and conditions of membership of the Television Society.

Name ____________________

Address ____________________

I desire to enrol as ____________________ (Fellow or Associate) and submit qualifications:—

Academic Qualifications ____________________ or

Scientific Pursuits ____________________

THE SECRETARY OF THE TELEVISION SOCIETY,

[Stamp enclosed.] 200, High Holborn, W.C.2.

ORDER FORM.

To TELEVISION PRESS, LTD.,
26, Charing Cross Road, London, W.C.2.

I enclose herewith {Postal Order / Money Order / Cheque} for 7/6 in respect of one year's subscription to "Television," commencing with the ____________ issue.

Name ____________________

Address ____________________

____

Postal and Money Orders should be crossed & Co. and Cheques should be made payable to Television Press, Ltd.

Announcement

Readers are reminded that the construction of any television apparatus, as described in the issues of this Magazine, constitutes an infringement of the Baird patents and renders the infringer liable to legal proceedings unless he is the possessor of the constructor's sub-licence that may be obtained in accordance with the offer contained on page 37 of the April issue.

* * *

APPLICATION FORM.

In accordance with the offer contained on page 37 of the issue of "Television" for April, 1928,

PLEASE WRITE IN BLOCK CAPITALS.

I ____________________ *(Full Name)*

of ____________________ *(Full Postal Address)*

____

____________________ *(Occupation)* hereby apply

to Television Press, Limited, for the issue to me of a CONSTRUCTOR'S SUB-LICENCE and agree to be bound by the provisions of such sub-licence.

A STAMPED ADDRESSED ENVELOPE MUST BE ENCLOSED WITH THE ABOVE APPLICATION.

(J)

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