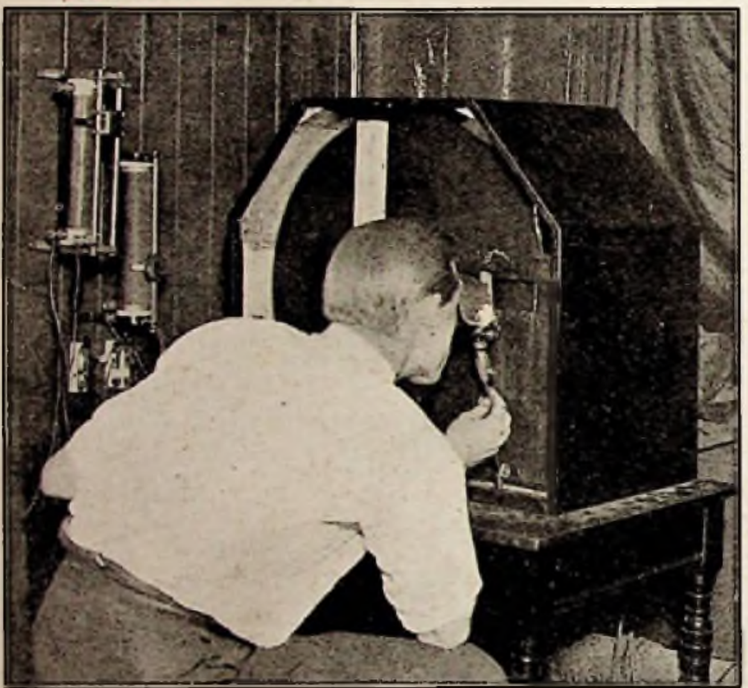
6D MONTHLY

Television

The Official Organ of the Television Society

VOL I. SEPT. 1928 No. 7



THE NEW STEREOSCOPIC TELEVISOR

In the picture shown above the figure is seen looking at a Stereoscopic Television Image through the viewing lens. A detailed description of this latest development is given in this issue.

THE WORLDS FIRST TELEVISION JOURNAL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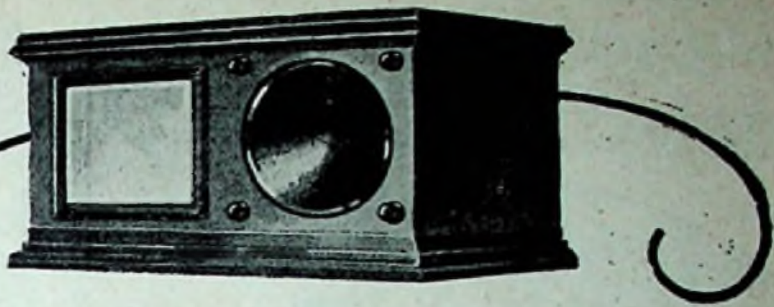

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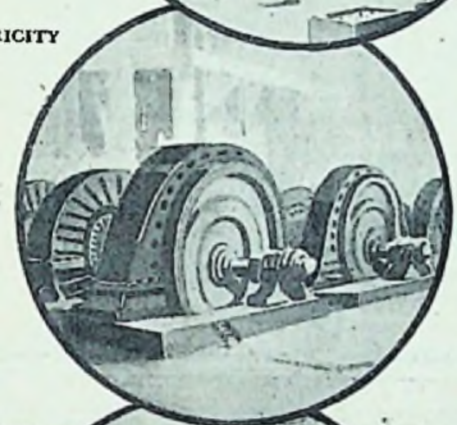

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Television

THE WORLD'S FIRST TELEVISION JOURNAL

The Official Organ of The Television Society

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Vol. 1] SEPTEMBER 1928 [No. 7

EDITORIAL

IN the first issue of TELEVISION we made the prophecy that progress in the new science of television would be rapid, and that while critics might stigmatise as premature the publication of a journal devoted exclusively to television, in that there would not be sufficient matter to sustain it, such progress and development would provide ample subject-matter to justify our existence.

* * *

DURING the past six months our expectations have been more than fulfilled. That period has seen the Atlantic spanned by television and living images of persons seated in London have been seen and recognised on board a liner in mid-Atlantic. In our July issue we described how television has now become possible in ordinary daylight, thus dispensing entirely with the need for any form of artificial illumination of the subject to be transmitted.

* * *

IN our August issue we were able to give a detailed description of still another development — television in colours. Further particulars of the apparatus employed are given elsewhere in this issue.

* * *

ON page 13 of our August issue our world-famous contributor, Mr. Shaw Desmond, by the exercise of his characteristically vivid imagination, made the following prophetic statement: "I do not doubt that ultimately either a genius like Baird, or another, will bring in the stereoscopic effect into the televisor."

* * *

WITHIN a few days of its publication this prophecy came true, and in this issue we describe how, on Aug. 9th, stereoscopic television was demonstrated by Mr. Baird in the presence of a group of scientists and press representatives. We ourselves were privileged to attend this demonstration, and we could not help being struck by the extraordinarily vivid and lifelike appearance of the stereoscopic image, as compared with the ordinary "single eye" television image.

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WHAT lies before?

* * *

BEFORE our next issue appears on the bookstalls the latest developments in television will have been demonstrated before a gathering of the world's greatest living scientists. We refer to the meeting of the British Association, which is being held this year at Glasgow, commencing Sept. 5th. Last year, at the British Association meeting at Leeds noctovision was demonstrated. This year, we understand, television in monochrome and in colours will be shown.

* * *

THIS will be followed almost immediately by demonstrations which will be given in premises adjacent to Olympia during the Radio Exhibition week, Sept. 22nd to 29th. According to an advertisement which appears on another page members of the public who desire to witness these demonstrations may do so by making application at the Baird Company's stands at the Exhibition. We are also promised that the Exhibition will mark the definite entry of the home televisor into the commercial world.

* * *

TELEVISION PRESS, Ltd., have taken a stand at Olympia, and will be found at Stand No. 11, Avenue A, immediately on the right after passing through the main entrance. We shall be delighted to welcome all comers.

OLYMPIA — 1928

Injured one: "I WILL see that Televisor, even if they kill me."

REFLECTIONS ON TELEVISION AND ITS CRITICS

By J. ROBINSON, M.B.E., D.Sc., Ph.D., M.I.E.E., F.Inst.P.

In this intensely interesting article Dr. Robinson presents a well reasoned argument in support of the Baird system of Television. The new science is at the very commencement of its career and presents unlimited scope for development. The writer points out that no good ever came out of purely destructive criticism, and suggests that further improvements will not be made simply by sitting down and waiting for them.

DR. ROBINSON.

The writer of this article is a very well-known figure in wireless engineering circles. His best-known invention is, perhaps, a type of wireless Direction Finder which he produced originally for use by the Royal Air Force. It is the most suitable form of Direction Finder for aeroplanes, but it is also used extensively by ships at sea. Dr. Robinson was formerly in charge of the Department of Wireless Telegraphy and Photography of the Royal Aircraft Establishment at Farnborough, and was later Director of Research to Radio Press, Ltd. He is also one of the earliest workers in photo-electric cells.

THE Editor of this magazine has asked me to contribute some views on the new subject of television. It is with the greatest of pleasure that I do so, as we are now at the commencement of the application of a new service, and one which is full of difficulties from all points of view.

These difficulties are so great that the technical and scientific worlds as a whole even now will not admit that any solution is in sight. This fact will stand out in the future, when television is a necessary part of life, as a testimony to the skill and imagination of the pioneers who have introduced the subject in its first practical form.

It matters not whether the apparatus in its present form will remain as standard, or even whether the principles employed now will remain permanently essential. **The pioneers have definitely shown that television is possible, that the time is ripe for it, and that from now onwards there will be steady improvement.**

Criticism and Scepticism.

It is not really surprising that the technical world has been so sceptical about television, and in fact still is so. There are many reasons why the average technical man should doubt the possibility of successful television, and the criticisms from this source are always given honestly. The subject is full of such vast complications that the average engineer who has knowledge of how complications influence performance cannot understand how all the various steps that make up television, and these steps form a very formidable whole.

There are the following steps to be considered :—

(*a*) It is necessary to transmit all details of a scene in motion, and there are no available devices such as the human eye, which is capable of appreciating all details simultaneously. It is necessary to divide a scene into a large number of parts and to obtain a light effect from each part in turn.

(*b*) The next problem is that as it is essential to record motion the whole of a scene must be given in an exceedingly short interval of time, this interval being smaller than the lag of the eye, which is conveniently taken as one-sixteenth of a second. This involves enormous speeds of scanning or examining every detail of an image.

(*c*) Each separate light effect must now be transformed into an electrical effect, and the photo-electric devices for this purpose are known to give exceedingly small currents. In order to make these currents suitable for transmission it is necessary to amplify them enormously. This, again, is likely to cause trouble because when huge amplification is obtained by thermionic valves there is a tendency to introduce disturbances owing to such things as irregularity of emission from the valve filaments.

(*d*) Then the transmission of these amplified currents introduces difficulties both for cable and wireless lines of communication. The electrical currents are varying at such high frequencies that it is necessary to allow for a type of communication which will carry equally effects at widely different frequencies.

(*e*) On receiving the electrical effects the problem of transforming these back into an image corresponding to the original scene presents difficulties just as great. As the frequencies are so high it is necessary to employ a source of illumination which will respond instantly to a change of the electric current. Obviously an incandescent filament is useless for this purpose as it has a comparatively large heat lag, and it continues to radiate light for quite an appreciable interval of time after the electric voltage is cut off.

(*f*) The next problem is to arrange that all the light effects thus produced are given in their correct position, and this involves a synchronous operation between the transmitter and the receiver.

Success Due to Mr. Baird.

These are the essential operations that must be performed, and each one is itself so difficult that it is not surprising that the average technician and scientist hesitates to attempt the solution, and even now doubts its possibility. However **the problem has been solved,** in any case initially, and the way to further successes has been paved by the pioneering skill and energy of Mr. Baird. Images of limited scenes have been transmitted from one point to another, and motion has been observed.

Obviously we cannot expect to have this complicated problem solved completely at one attempt, but **we are highly satisfied that progress has gone so far that we can now see heads of individuals in motion, that we can recognise these individuals and observe the various movements they make.**

Before the Three-Electrode Valve.

The progress made so far tends to confound a very general opinion that is held in the scientific world even now, which is that in view of the complications of television we cannot hope for a satisfactory solution until there is some entirely new discovery. No one can give even a hint as to the lines on which such discovery is required, but the general opinion is that the discovery should make the same difference to television that the thermionic valve made to wireless. Such a new discovery would undoubtedly be very welcome, as it is even now impossible to estimate the immensity of the improvements introduced into wireless by the thermionic valve.

It is impossible to say whether such a discovery will ever come along for television, but we are not likely to get it by sitting down to wait for it. The best method of advance is to proceed along the lines already indicated, and a considerable amount of progress will be made. After all, by analogy with wireless, there was quite a large amount of successful wireless communication accomplished before the discovery of the three-electrode valve.

Further, this valve was discovered by someone who was working in wireless. **Thus, rather than wait for some new discovery, a start should be made with the application of television.** This will bring into the field a large number of enthusiastic workers, and this is surely the best way towards the new discovery if one ever does materialise. If it is not forthcoming then there is no doubt that television will *still* go ahead and be established as a necessity of life.

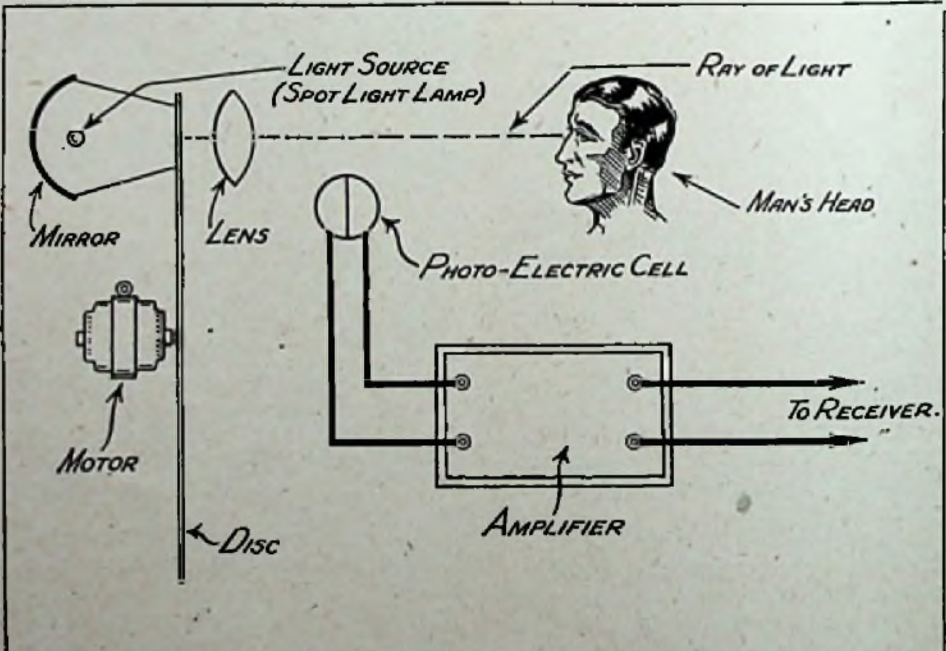
What the Critics Say.

There are other critics of television, also with an honest purpose. One type is comparatively easy to answer. He is the critic who states that the results so far are not good enough, and that they are not likely to be good enough for many years to come. A very usual remark is that the public has become accustomed to the most perfect reproduction in telephony broadcasting, and thus they will not tolerate any deficiencies in the broadcasting of television.

There is no doubt that the quality of broadcasting that we are accustomed to in Great Britain is excellent, but it is not so many years ago since wireless telephony was of a type that would now be considered to be very distorted.

Remarkable progress has been made in wireless telephony and there is no reason to doubt that we shall get similar progress in television.

It is not easy to see why, because a subject is new and full of potentialities, it should be condemned for present imperfections. Similar criticisms have been made about many new developments. Many of us remember similar criticisms about motor cars, and almost all of us have heard them about gramophones and the cinematograph, and I dare say it is even possible now to find some people who will not tolerate these ordinary services. The ordinary telephone service also had its critics, and they still exist. Where would we have been with all these essentials of life (and the list could be amplified) had the critics triumphed over the pioneers?



COLOUR TELEVISION TRANSMITTER.

The disc has three spirals of red-, blue-, and green-covered holes, through which a light spot shines on to the object to be transmitted, as described in detail in our last issue, and on page 28 of this issue. Coloured light reflected back from the object affects a photo-electric cell, or battery of cells, placed as shown.

Inexpensive Apparatus.

Another type of criticism is perhaps not quite so easy to deal with, and that is that the cost of television will be prohibitive.

It is perhaps early to discuss this subject, but we do know that the first television receiver of the Baird Co. will not be too costly. A reply of this nature will, however, not satisfy these critics, for they insist that they are referring to perfect television, or to scenes that one would wish to see many times. Whether broadcast receivers which will give perfect reproduction of the Derby, a cricket match, a football match, a boxing match, or a theatrical performance, will be cheap enough to be installed by every citizen in his own home it is difficult to say.

Problems of cost, however, arise very frequently in new developments, and the courage of the pioneers has usually overcome them. In time an economic cost will develop, when the public has become accustomed to the application of television, and the results which will be obtained will create a demand in accordance with the cost.

Future Developments.

However, considering the rapidity with which progress has been made up to the present we can look forward with confidence to similar rapidity in future developments, and we may be much nearer the condition of seeing the Derby from one's own armchair than we at present anticipate.

This raises a very important point as to what will be the most obvious application of television. At present it certainly appears as if the cost for perfect reception of television will be outside the reach of the average citizen. So also is a cinematograph projector, but this has its own peculiar form of commercial application. Whether the greatest application of television will be along lines similar to the cinematograph, or along broadcasting lines, it is not easy to foretell, but there is no doubt that there will be a very large commercial application of television in a collective manner, which is in halls similar to cinema halls.

There is another aspect of television which is of the utmost importance at the present time. As the subject is so full of difficulties, great care should be taken to avoid culs-de-sac. All developments, particularly if they affect the public generally, should be of such a nature that it is not necessary to scrap apparatus wholesale when any progress is made in transmission.

The Danger of Culs-de-Sac.

For instance, suppose that broadcasting apparatus is supplied to the public which deals with images divided into a particular number of strips, say 30. When a decision is made to change the transmission, say, to broadcast larger scenes with the same definition, on the same sized screen with more detailed definition, it should be possible for every member of the public who possesses a receiver to make the necessary changes without the necessity of purchasing entirely new apparatus and scrapping the old apparatus. This is given merely as an example, but in every case of broadcast the problem must be borne in mind.

DR. ROBINSON remarks that: "Considering the rapidity with which progress has been made up to the present we can look forward with confidence to similar rapidity in future development, and we may be much nearer the condition of seeing the Derby from one's own armchair than we at present anticipate."

In this connection it is of interest to note that the B.B.C. is considering the broadcasting of still pictures. This feature of a possible cul-de-sac should recommend itself to them, for still pictures can be transmitted at various speeds, and it is doubtful whether any single instrument for reception can be made adaptable to all speeds of transmission which are within the capabilities of the B.B.C.

Why any consideration should be given to the broadcasting of still pictures is a problem for the B.B.C., but this appears to me at first sight to be a service entirely apart from broadcasting. If broadcasting of vision is to be considered at all it should surely be of motion pictures, and from this point of view it would appear as if the B.B.C. would enter a cul-de-sac of the type here specified if they do commence the broadcasting of still pictures.

This question of culs-de-sac is one intimately associated with broadcasting and does not arise with still pictures if these are restricted to press work or telegraphic work. The scrapping of a machine in these types of work is not a serious matter, as the number of machines concerned is not great. The same remark applies to the public hall application of television.

The whole field of television is thus in a very interesting condition, as there are problems to be solved in all branches, not merely in the perfection of apparatus, but in the methods of application, and this journal should assist considerably towards the solution of all these problems.

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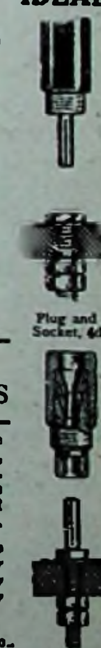


Plug and Socket, 4d.

Socket and Plug, 4d.

Television and Broadcasting

By The Technical Editor

Our readers have, no doubt, noticed the absence from our columns recently of the Technical Editor's "Technical Notes." This omission has been due to the fact that the Technical Editor has been absent on a visit to the United States. In the following article he outlines some of the impressions which he has gained.

LONDON is the television centre of the world. Whether or not it is rash to make such a statement, it is my considered opinion after travelling in America for four months with eyes and ears wide open. The opinion was not formed until after I reached home, for I was out of touch with all the recent developments here, and in fact must admit that I did not even see the recent numbers of this magazine until I reached London again.

I always feel rather sorry for the American general public, because they are not as well served as we are in this country in the way of general news. During my stay there I only once heard any mention of Baird television, in spite of the fact that television is almost a general subject of conversation. The reason is a very simple one

Patriotic Publicity.

Publicity in America always tends to be patriotic—if one may debase the meaning of this word—and the exploits of Americans are applauded to the complete exclusion of similar or better exploits by foreigners. This was brought home very clearly, when I read in the leading New York newspaper an editorial article devoted solely to explaining that Lindbergh was not the first man to fly across the Atlantic!

Although this kind of publicity is rather obnoxious to us in this country one really wonders whether it would not be sound policy for us as a nation to adopt it, at least to some extent.

There is no need to enlarge on the general thesis of the part which publicity and advertising plays in American life, but it was interesting to note how it affected the whole question of broadcasting. The listener over there pays no fees directly for his programmes, for they are all supplied as indirect publicity for someone or other. One result is that the programmes are much more "popular" than they are here, and hence more entertaining, and I think the B.B.C would be well advised to lower its standard somewhat, so as to approximate to the American level in the interests of the general listener.

IT is very interesting to note that our Technical Editor, after an extensive tour of the States, returns with the conviction that "London is the television centre of the world."

One very important factor in connection with the American broadcast system which has impressed him is that it is "ready for television."

In contrast to this, our Technical Editor admits dismay at the attitude towards television which has been adopted by the B.B.C. in this country.

The matter about which I really wish to write here is not a criticism of British broadcasting, but the possibilities of broadcasting television. As matters stand at present there is a grave risk that the broadcasting of television (not transmission to a few isolated observers) might easily take place in America before it happens in this country, for the simple reason that the American broadcasting system offers such opportunities, and in fact invites experimental novelties. In a word, the American broadcast system is *ready* for television, and it is clear that as soon as any television apparatus is available in America appropriate broadcasting will commence, with the inevitable result that the whole science will progress more rapidly.

The recently published developments of the Baird system in which daylight illumination has been used, and colour television has been transmitted, show that this country is far ahead of America at the present time, but it is quite reasonable to speculate as to whether the lead can be maintained when the whole onus of development is thrown upon a single company, or even upon a single inventor.

The Baird Television Development Company have promised that apparatus will be on sale within the next few weeks, and that they will broadcast television; all honour is due to the enterprise of those in control of the company, but I should like to see some further support accorded to them.

Attitude of B.B.C.

I have been rather dismayed at the attitude which appears to have been taken up by the B.B.C. on the question of television. The B.B.C. is no longer a private corporation; it is now a national organisation, and I quite seriously ask that those in control of it should take a very broad national view of all questions which come within their scope. Undoubtedly television is one of these questions, for it can be so closely allied to broadcasting, and the least that they should do is to provide facilities for the broadcasting of television.

I have not recently seen any reasoned statement of the views of the B.B.C. on television, but the *obiter dicta* which one comes across appear to suggest that they are not only inadequately informed, but also uninterested, and it is that attitude which is so much to be deplored. I venture to suggest that it is the duty of the B.B.C. to be interested in television upon purely national considerations if no others. We do not want the history of the synthetic dye industry to be repeated in the television industry.

On August 9th the writer of this article had the privilege of seeing the latest production of the Baird Television Co., namely, stereoscopic television. The method employed was identical in optical principle with that employed in the production and reproduction of ordinary stereograms.

The object was placed in front of what was in essence a stereoscopic camera. The two pictures—right and left—were transmitted to the receiving station, where they appeared side by side. These pictures, therefore, when viewed by an ordinary stereoscope, gave a picture in relief of the object—a human head—transmitted. In this simple way has another milestone been passed on the way to the achievement of that magical combination of the wireless transmission of perfect hearing with that of perfect seeing.

Stereoscopic Vision

By Prof. CHESHIRE, C.B.E., A.R.C.S., F.I.P.

Inspired by the wonderful achievement of stereoscopic television, our contributor has written this very informative article on a subject which is very little understood or appreciated by the ordinary man in the street.

WHY are two eyes better and more useful to us than one? What are the peculiar features of human binocular vision? One obvious reply to these questions is that the field-of-view is much greater for two eyes than it is for one. A man looking straight ahead, in a horizontal direction with fixed eyes, can see something to the right and left, in a horizontal plane, over an angle of more than 180°.

Objects in front, over an angle of roughly 90°, are seen with both eyes. Objects to the right of this are seen by the right eye only; objects to the left with the left eye only. With one eye only, therefore, the field is one-sided, and is limited to an angle of about 130° to 140°.

But apart from this obvious advantage of two-eyed vision there is another of perhaps much greater importance, which is less obvious. Let us go into the garden and stand some five or ten yards away from a bush, preferably one with medium-sized leaves of irregular outline. A holly bush of the variegated leaf variety will serve our purpose admirably.

With head kept still—this is important—and one eye closed what do we see? Nothing more than a confused jumble of leaf and twig, massed, so far as can be seen, at the same distance away. If, now, the covered eye is brought into use, so that the bush is seen with two eyes simultaneously, a marvellous change comes over the picture. Every detail of the tangled mass of foliage before seen now stands out boldly separated, and at its proper distance along the line of sight. The bush is seen in relief, i.e., as an object with height, breadth, and *depth*. With one eye only, depth cannot be seen—it can only be judged.

Distance can be judged by (1) the apparent size of known objects, as determined by the laws of geometrical perspective; (2) the change in perspective attending a change in the point of view; (3) the change in the accommodation of the eye necessary to observe objects at different distances; and (4) aerial and chromatic perspective. These causes are operative both for single and two-eyed vision.

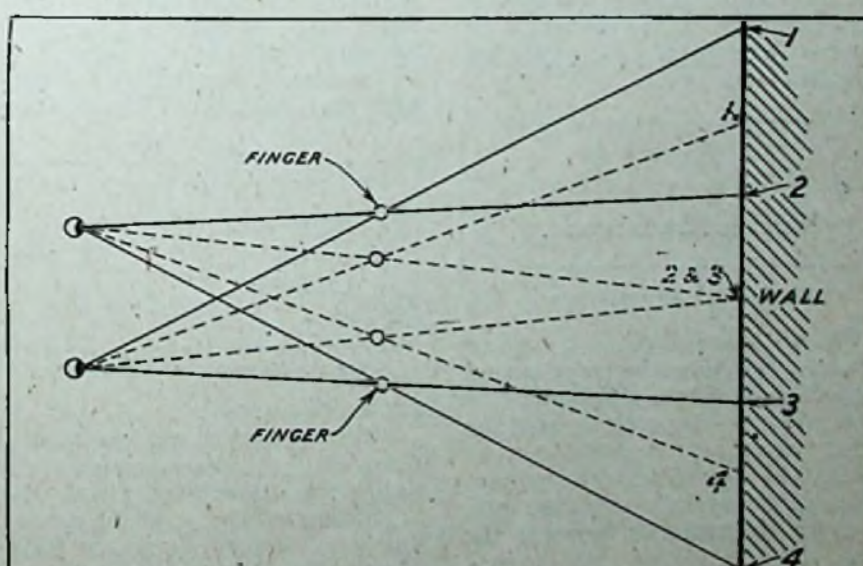


Fig. 1.—Superposition of images in two-eyed vision.

In two-eyed vision another factor comes into operation—the power to direct or converge the lines of sight of the two eyes in succession upon points at different distances away, and thus secure the impression of relief characteristic of stereoscopic vision.*

Experiments in Stereoscopic Vision.

Experiment 1.—Stand a few feet away from a wall as lightly and as uniformly coloured as possible.

* That stereoscopic relief accompanies changes in the convergence angle is undoubtedly true, but to what extent it is dependent upon it is still a moot point.

(A whitewashed ceiling acts admirably but it imposes positions upon the experimenter which may bring his sanity under suspicion.) Hold a finger up at arm's length and close one eye, keeping the head still. The finger is seen opposite to a certain spot on the wall. Now look at the finger with the other eye—it is seen projected upon another part of the wall.

This apparent displacement of the finger is sometimes spoken of as parallactic displacement, or displacement dependent upon the point of view. Now use both eyes on two fingers held vertically at arm's length and about three or four inches apart. *Focus your eyes on the wall.* Four fingers will be seen projected against different parts of the wall, as shown in plan by Fig. 1 in full lines.

Merging Double Images.

Now bring the two fingers slowly together. The images 2 and 3 will approach one another until they overlap, when *three* fingers only will be seen, but the middle one will have two finger nails.

Success in this fundamental experiment depends upon keeping the eyes focussed upon the wall; if a finger is focussed the illusion disappears. For the further carrying out of this experiment it is worth while to construct a simple piece of apparatus with two large pins.

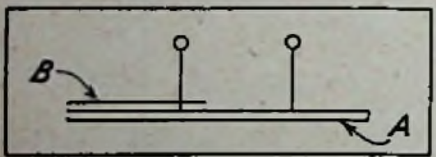


Fig. 2.—Two-pin range-finder.

One of these is fixed in a strip of wood A, and the other in a second strip B, adapted to slide upon the first. With this apparatus repeat the finger experiment. Superpose as before the two inner images and then very carefully increase and decrease the distance between the pins.

Within certain limits the two superposed images cling together and remain single in appearance, but, strange to say, *it appears to move backwards and forwards along the line of sight*, and this apparent displacement is actually used in the modern stereoscopic rangefinder.

In the simple apparatus we have described, if the pins are maintained at a fixed distance from the eyes, and the separation of the pins be adjusted until the middle or stereoscopic image appears to have moved outwards to touch an object some 10 or 20 yards away, say, then the distance of that object can be determined thus: Knowing the separation S_1 of the two eyes O_1 and O_2, the distance d of the vertical plane of the pins, and the separation S_2 of the pins when finally adjusted, then we have from the properties of similar triangles

$$\frac{D}{D-d} = \frac{S_1}{S_2}$$

$$\therefore D = \frac{dS_1}{S_1 - S_2} \quad . \; . \; . \; (1)$$

In an example the separation of the eyes S_1 was 2·5 in., the distance d of the pins 12 in., and the separation of the pins S_2, 2·4 in. Thus the distance of the object from the observer was

$$\frac{12 \times 2{\cdot}5}{(2{\cdot}5 - 2{\cdot}4)\,12} = 25 \text{ ft.}$$

It is a remarkable fact that whilst the modern and almost universally accepted theory of stereoscopic vision was not advanced until 1838 by Wheatstone,† yet as far back as 1738 there occurs in Smith's "Compleat System of Opticks" a description of an experiment identical in principle with that described above. These

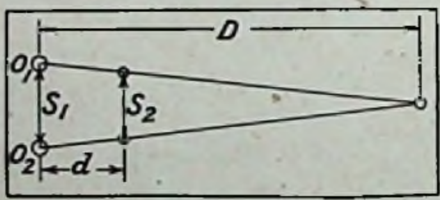


Fig. 3.—Diagram for range-finding.

are Smith's words:—

"Having opened the points of a "pair of compasses somewhat wider "than the interval of the eyes, with "your arm extended, hold the head, "or joint, in the ball of your hand, "with the points outwards, and "equidistant from your eyes, and "somewhat higher than the joint. "Then fixing your eyes upon any "remote object lying in the line that "bisects the interval of the points, "you will first perceive two pairs of "compasses (each leg being doubled) "with their inner legs crossing each "other, not unlike the old shape of "the letter W. But by compressing "the legs with your hands the two "inner points will come nearer to "each other, and when they unite "(having stopped the compression) "the two inner legs will also entirely "coincide and bisect the angle "under the outward ones, and will "appear more vivid, thicker and "longer than they do, so as to reach "from your hand to the remotest "object in view, even in the horizon "itself, if the points be in exact "coincidence."

Experiment 2.—Draw upon a slip of cardboard the part of Fig. 4 shown in full lines. It represents two pins lying point to point, but angularly separated at an angle of about 1 in 4 (15°). Hold the card horizontally just below the level of the eyes, at a distance of about 10 inches, and with the point of the V pointing inwards.

Look at this point intently, when a vertical black pin will be seen vividly standing up vertically out of the paper, as shown in dotted lines. The illusion is so complete that many seeing it for the first time put out a hand to feel the pin. The explanation is simple. One eye looks above and along one

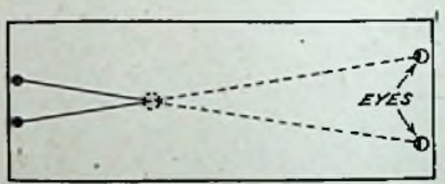


Fig. 4.—Diagrammatic representation of an experiment which illustrates stereoscopic vision in a simple manner.

of the pins or black lines, and the second eye looks along and above the other. Thus lines drawn from the eyes to the two pinheads thus intersect in space above the point of the V and produce the fused stereoscopic image there seen.

Fig. 5 shows two simple stereograms of a short length of conical tubing—a hollow truncated cone. The upper pair of figures shows the tube end on, with the smaller end behind; whilst the lower pair shows the same tube, but with the smaller end in front.

† The interested reader is advised to read the two classical papers by Wheatstone on the subject. The first appeared in the "Philosophical Transactions" for 1838, and the second in the same journal for 1852.

Considering first the upper figures, imagine an observer with eyes O_1 and O_2 fixed in position, placed in front of the tube at A, Fig. 6, with a sheet of ground glass S interposed, which allows of the tube being seen through it. Then with the eye O_2 the projection of the tube A upon the screen S is traced at R, and from the point O_1 the projection L of the tube A is similarly traced. The upper figures of Fig. 5 are these two projections.

It is interesting to note, finally, that a stereoscope is not necessary to combine two pictures. In Fig. 6, for example, it is obvious that if by any means the visual axes of the two eyes O_1 and O_2 can be directed through the points 1 and 1^1 reconstruction of the point 1_0 must occur. If then by the adjustment of the convergence angle the points 2 and 2^1, 3 and 3^1 and so on can be optically fused, reconstruction of the entire object is secured.

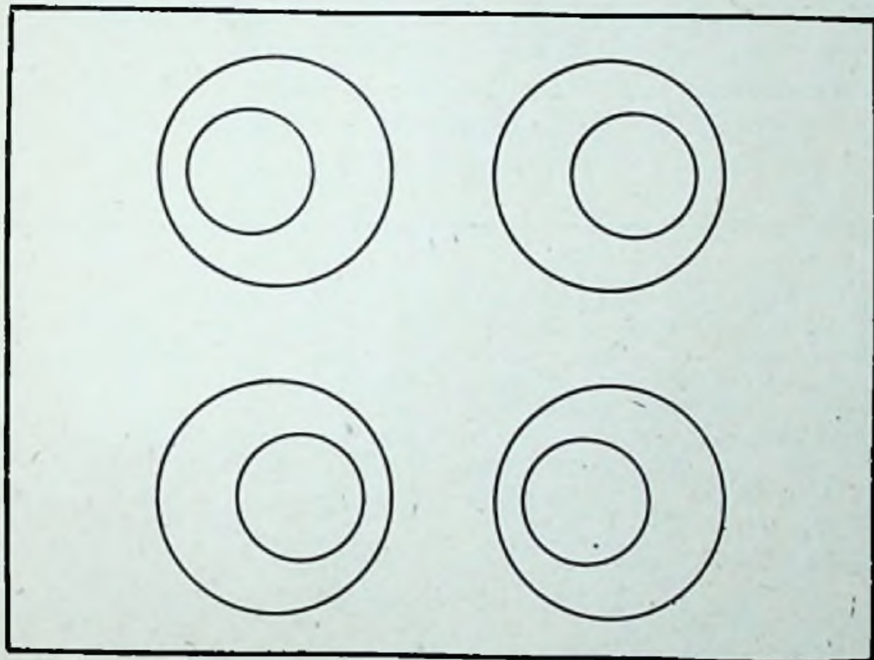


Fig. 5.—Stereograms of a truncated cone.

ANOTHER EYE-WITNESS' REPORT.

Dr. C. Tierney, D.Sc., F.R.M.S., writes :—" On August 9th, in company with Prof. Cheshire and others, I visited the Baird laboratories and witnessed the first demonstration of stereoscopic television. A man sitting before the transmitter was very clearly seen on the screen of a receiver situated in another part of the building, in perfect relief, showing the facial delineation and expression both with and without optical assistance. These experiments promise considerable development and importance in their practical application. Prof. Cheshire demonstrated the practicability of fusing the two visible images by the human eye without the aid of optical instruments."

Having obtained our stereographic projection in this way, to reconstruct the object it is only necessary to place the stereogram in a stereoscope, maintaining the original separations, and provided with focussing lenses, as shown in dotted lines, Fig. 6. The reconstruction of the four points, 1_0, 2_0, 3_0, and 4_0, of the object, now assumed to be away, is effected in the way explained under Experiment 1 above. The points 1 and 1^1 are stereoscopically superposed to produce an image at 1^0. Similarly with the pairs of points 2 and 2^1, 3 and 3^1 and 4 and 4^1. All the points of the object A are thus reproduced in space so that the stereoscopic image seen with the assistance of the stereogram S, only, is indistinguishable from that obtained by looking at the object directly. The retinal pictures in both cases are the same.

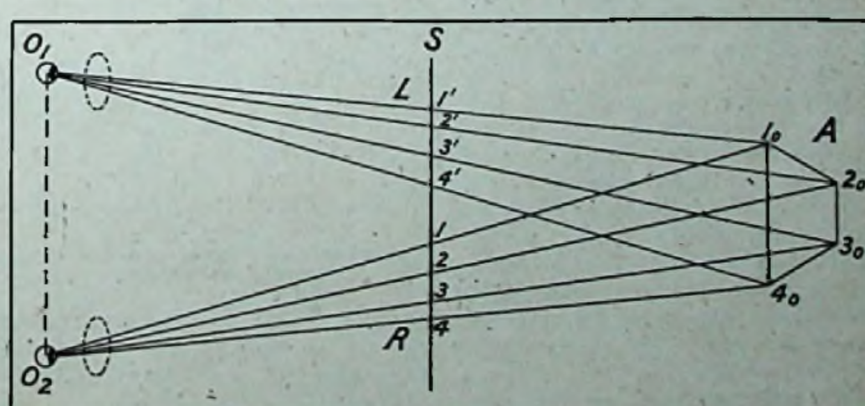


Fig. 6.—Construction of stereogram Fig. 5.

N.B.—Owing to the scientific importance and topical interest attached to stereoscopic television, Prof. Cheshire has broken his series of articles on "Optical Reflectors" in order to give our readers an insight into the little understood phenomenon of stereoscopic vision. Next month Prof. Cheshire will resume his popular series of articles.

The Influence of Polarisation and Frequency on the Photo-electric Effect

By H. WOLFSON

This month Mr. Wolfson has many interesting and enlightening things to say on the subject of light in its different forms and colours, and how these different forms and colours affect the photo-electric cell—that vital instrument which is the heart of a television transmitter. The article is of particular value to our readers as it will enable them to comprehend more completely the problems involved in colour television, which was described in our last issue.

IN order that we may obtain an even response from the photo-electric device over the entire range of the visible spectrum, to ensure the transmission of the correct tonal value of light and shade, it becomes necessary that we should understand more completely the influence of the frequency, and to a lesser degree the state of polarisation, of the light which falls on the cell.

A short account of the meaning of polarisation may be of advantage to those who have not previously studied the subject.

Ordinary light from a point source may be considered as vibrating in every conceivable plane at right angles to the direction of transmission, as is shown diagrammatically in Fig. 1.

If, however, we place in the path of the beam of light a crystal of calcite which has been cut in a special manner and then cemented with Canada Balsam (this constitutes the well-known Nicol's Prism), we are able to suppress all waves vibrating as described, with the exception of one wave only, which vibrates in *one plane only*. This wave consists of polarised light.

We will now consider the exact mechanism by which this polarisation is brought about. Let us imagine the crystal to be formed of a number of thin superimposed layers like the pages of a book. The light, vibrating in a number of planes, strikes against the edges of the leaves, as shown in Fig. 2A, and, since light travels in straight lines, it becomes at once evident that only those waves which are vibrating in a plane parallel to the slits between the pages will succeed in passing through the book, the other waves being stopped. The crystal of calcite is formed in a manner very similar

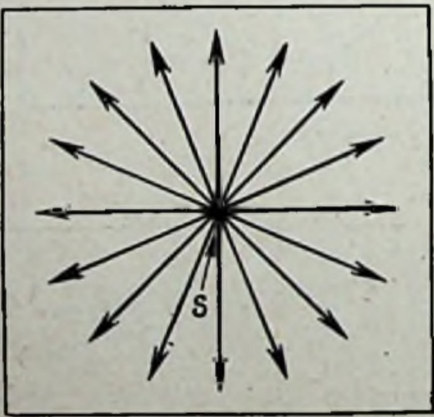


Fig. 1.
Illustrating a few planes of vibration of light waves from a point source, S.

to the book, and the arrangement of the atoms in layers is known as the space lattice formation of the crystal.

If now we place two similar crystals in the path of the beam of light, arranged so that the axis of one crystal, and consequently the layers, is at right angles to the axis of the second, then there will be total extinction of the light. This is more easily grasped with the aid of the book analogy, and Fig. 2B shows the arrangement of books with axes at right angles, and it then becomes an easy matter to understand just how this total extinction of the light comes about. If the axes were inclined at an angle, a small percentage of light would be transmitted, dependent on this angle.

It is possible to turn the plane of polarisation through various angles by placing in the path of the light certain "optically active" substances, often in the form of a solution, such as sugar, etc.; but as this is of passing interest only, I must content myself with merely mentioning the fact.

Hertz, who in 1887 made the first observation on photo-electricity, was unable at any time to observe that the state of polarisation had any influence on the photo-electric effect.

Elster and Geitel, two workers who have done much to forward the science, were able, however, in 1894, to show that there was an effect due to the incident light being polarised. They worked with a cell of the sodium-potassium alloy type, contained in a glass vessel at the critical pressure (about one-third of a millimetre) at which the maximum value of the photo-electric current is obtained.

The circuit they employed is shown in Fig. 3, and consists of the cell C, which is connected in series with a sensitive galvanometer G, and a 250-volt high tension battery. Polarised white light was directed on to the cell so as to be incident at 45°. The maximum photo-electric current was obtained when the plane of polarisation was perpendicular to the plane of incidence; that is, the angle between the two planes was 90°, or one right angle.

In simple terms let us imagine that the plane of incidence is represented by the plane of the table. Then a plane perpendicular to this could be formed by holding a piece of card so that one edge rested on the surface of the table. On the other hand, a plane parallel to the table is represented by placing the card flat on the table.

Response Ratio.

The ratio of this maximum current to the minimum current obtained was about 10 to 1. For those who are interested in the more exact mathematical expression for the value of the current for any angle α between the planes of polarisation and incidence, I give the equation: $I = A \cos^2\alpha + B \sin^2\alpha$, where A and B are constants, and I represents the photo-electric current.

In the following table, taken from the original paper by Elster and Geitel, we can see to what degree the photo-electric current depends on the angle of incidence, and since data is given for light polarised both at right angles to, and in, the plane of incidence, the reader can easily verify for himself that the ratio of maximum to minimum current is as stated above.

TABLE I.

Angle of incidence (degrees).	Light polarised perpendicular to incident plane.	Light polarised in incident plane.
0	2·8	—
3	—	2·8
10	5·2	2·78
20	11·2	2·87
30	17·4	2·65
40	23·4	2·24
50	27·0	1·80
60	28·7	1·51
70	23·8	1·01
80	11·0	0·33

The maximum current recorded is in the first column, at an angle of incidence of 60°, and alloys of the metals of the "Alkali Group," i.e., sodium, potassium, rubidium, and cæsium give very similar results.

The same two workers investigated the effect of the state of polarisation on the number and velocity of electrons emitted by the photo-electric substance, but in this case employed the most complete vacuum in the cell which could be obtained, finally removing traces of residual gases by means of glowing calcium. They then found the following interesting results:—

(1) The number of electrons is considerably greater when the plane of polarisation of the light is perpendicular to the plane of incidence than when it is parallel to the incident plane, the ratio being at times as great as 50 : 1.

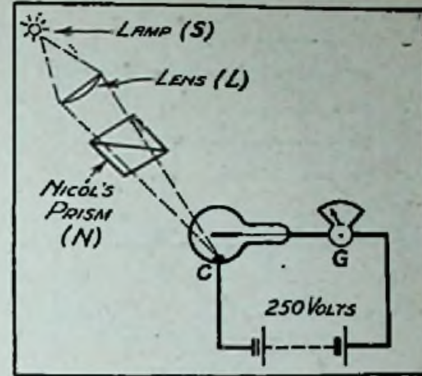


Fig. 3.
Polarising Apparatus.

(2) The velocity is practically unaffected by the relative positions of the planes of incidence and polarisation.

(3) The number of electrons whose velocity is less than the maximum is greater when the plane of polarisation is perpendicular.

Not only has the state of polarisation an influence on the photo-electric current given by cells of the alkali metal type, but as has been shown by Pohl, the number of electrons emitted from platinum, copper, mercury, etc., with highly polished surfaces, depends on the azimuth and angle of incidence of the light employed, in this case ultra-violet; whereas, the work of Elster and Geitel dealt only with light of the visible spectrum.

"Normal" and "Selective" Effects.

Pohl found that, contrary to the results obtained by the latter workers for the alkali metals, it is immaterial whether the light be polarised perpendicular or parallel to the plane of incidence. This brings us to the brief consideration of the so-called "normal" and "selective" effects, which Hughes has rightly described as "one of the most puzzling phenomena in the subject of photo-electricity."

The results of Pohl and Pringsheim have at last accounted for the discrepancies in the data obtained by previous workers. The graphs in Fig. 4 show the photo-electric current and wavelength per unit intensity in the incident polarised light from a mono-chromatic source. The curve E⊥ refers to light polarised in the plane at right angles to the incident light, while that marked

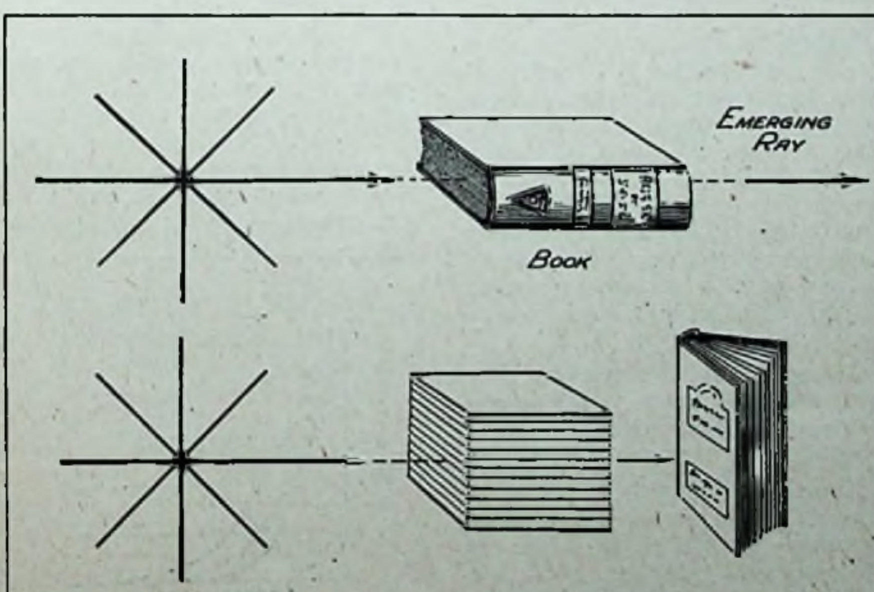


Fig. 2.
Upper drawing shows, by using a book analogy, how light is polarised in a single plane. Lower drawing, again by means of a book analogy, shows how, by placing two polarising crystals at right angles to each other in the path of a beam of light, the beam becomes totally extinguished.

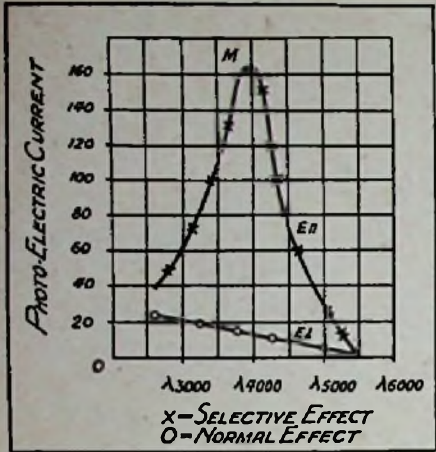


Fig. 4.

E ∥ indicates that the light is polarised parallel to the incident beam. This curve is very different from the former curve and may be regarded as made up of two curves, one of the type E⊥ and the other of the type obtained for the selective effect illustrated in Fig. 5, which was obtained by subtracting the known normal effect from the total effect.

Thus Pohl and Pringsheim imagine two different effects as being operative in the case of the alkali metals, the "normal" effect which increases with increasing frequency of the light, and which is independent of the state of polarisation of the light, and the "selective" effect, which appears only when the light is polarised in the E ∥ plane, and with certain limitations as to the frequency of the exciting light.

A Possible Explanation.

Although the number of electrons emitted in the "selective" effect is far in excess of those concerned in the "normal" effect, it has been shown by Hughes that their velocities differ only slightly. A possible explanation of the selective effect, put forward by Pohl and Pringsheim, is that a molecular resonance phenomenon is responsible, in which the electrons follow the electric force (i.e., the light wave); and the fact that the number of electrons liberated is much greater when this force has a component normal to the surface is then readily explained.

If this view is correct we must assume that all the systems concerned have the same period, that is a frequency corresponding to the maximum wavelength, marked M on Figs. 4 and 5. The observation has also been made that the selective region is also the region of high reflecting power.

The velocity of the electrons emitted under the influence of light can be measured by observing the positive potential created (denoted by "V") and substituting in the equation which represents work done in moving an electron $Ve = \frac{1}{2}mv^2$. Thus the potential produced on illuminating a photo-electric cell is directly proportional to the square of the velocity of the electrons projected under the influence of the light.

Thus Ladenburg found for the metals platinum, copper, and zinc that the initial velocity of the electrons increases with increasing frequency of the exciting light.

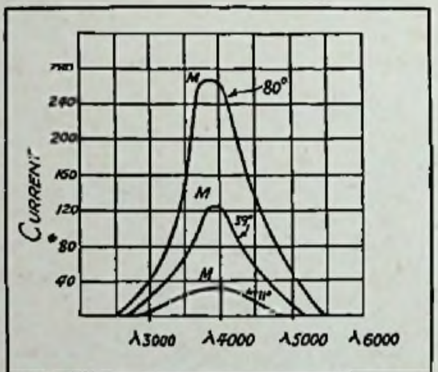


Fig. 5.
Selective effect for Na/K alloy at different angles of incidence.

A typical example from his results for the three metals just mentioned gives an increase in potential from 1·075–1·86; 1·01–1·69; 0·685–1·12 respectively; all taken over the frequency range, $1{\cdot}15 \times 10^{15}$ $1{\cdot}49 \times 10^{15}$. The graph in Fig. 6, reproduced from Ladenburg's results, shows clearly the increase of sensitiveness with a decrease in wavelength (which is the same as an increase in frequency).

A number of later workers have criticised these results, and the conclusions which Ladenburg draws from them, as being very doubtful.

Experiments carried out by Hughes have definitely proved that it is the maximum energy of emission, not the maximum velocity, which can be expressed as a linear function of the frequency of the incident light. Hughes adopted elaborate precautions to avoid falsification of his results by such things as surface films on the metal surfaces, imperfect isolation of definite wavelengths, and the presence of scattered light of short wavelength.

The first of these difficulties he overcame by distilling the metals in vacuuo, while the use of a Hilger quartz spectograph as a monochromator, i.e., a source of light of a particular frequency, removed the second source of error. He used a quartz mercury vapour lamp, which most of us are familiar with to-day as an "artificial sunbath," as the source of light. Every trace of gas was removed from the apparatus by means of a Toepler pump, and charcoal, cooled in liquid air, was used as a "getter" to remove the last traces remaining after this pump had reduced the pressure to one hundredth of a millimetre.

Emission Velocities.

Some results obtained for cadmium are sufficient to convince one that this work does show the necessity for a complete investigation and a thorough understanding of the effect of the frequency of the light on the emission of photo-electrons, and the table given below shows that the velocity predicted by the energy law mentioned above is in better agreement with the value obtained by actual experiment than that predicted by Ladenburg's rule. More especially is this the case for the frequency 2329×10^{12}, which, unlike the experimental values for frequency 1010 and 960, is unaffected by the earth's magnetic field. Ladenburg's law indicates an emission of electrons at a frequency of 750×10^{12}. Actually the emission ceases between frequencies 960 and 898×10^{12}, which is in agreement with the energy law.

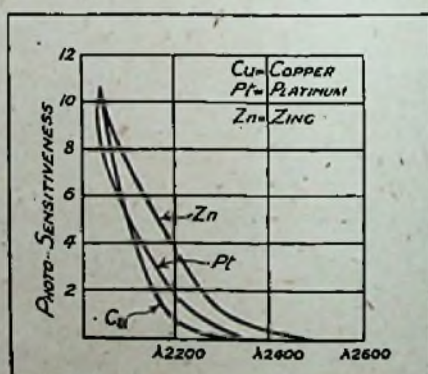


Fig. 6.

(*Continued on page* 39.)

Light: The Essential of Television

Part I.

By CYRIL SYLVESTER, A.M.I.E.E., A.M.I. Mech. E.

Light is one of the most important factors in connection with television, and one which must be carefully studied by all serious television students and experimentalists. The principles and nature of light are by no means so widely known and understood as one would anticipate, and in this series of articles our contributor will proceed to elaborate them.

IN all sciences there are essentials which must be thoroughly understood before appreciable progress can be made. In the development of the steam turbine the essential was thermodynamics; in wireless broadcasting and reception the essential was a sound knowledge of alternating current phenomena (that is, the effect of alternating or fluctuating currents upon inductance and capacity); and so, with television, it will be found that the essential will be an intimate knowledge of both natural and artificial light.

The Uses of Ordinary Daylight and Artificial Light.

I have coupled ordinary daylight and artificial light together because it will be found to be necessary to use both. That is, the animated scene on the screen of a televisor, to be seen at the instant of occurrence, will not be the limit of television reception. Apparatus will be developed by means of which a permanent record of a scene will be obtained to be subsequently transmitted as considered necessary. To mention a case to illustrate this we will assume that it is, say, Derby Day, and that on the televisor screen in our home we have seen the Derby winner pass the post. A record will be taken so that the scene can be re-transmitted for the benefit of those who are at home in the evening, and who did not see the actual reception in the afternoon.

Those who have seen the race, through the medium of the televisor, at the instant of occurrence, will have done so through the medium of natural daylight; those who see it in the evening will see it reproduced by means of artificial light. But there is a difference between natural and artificial light, a difference which must be understood by experimenters in television if rapid progress is to be made. The difference between natural and artificial light includes many factors; the intensity is different, the colour quality varies, and (as I will show later) the *effect* will vary. It is in the rectification of this effect that a good knowledge of light desirable.

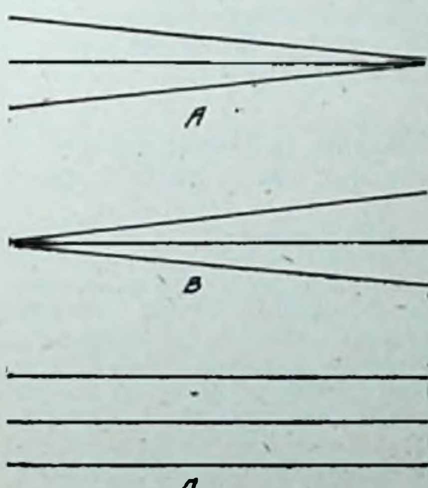


Fig. 1.
Illustrating divergent, convergent, and parallel light rays.

All objects are seen by the light which is reflected from them. A black object against a black background cannot be seen; the same may be said of a piece of white paper, if placed perfectly flat upon a sheet of paper of the same colour quality. If, however, a black object is placed against a white background, it can be seen because we have extreme contrasts. The black absorbs the whole of the light incident upon it, and the white reflects practically the whole of the light. Whether the object will have shape or not will depend upon the direction of the light; and this applies either with natural or artificial light.

With regard to natural light we will assume that we are in a garden flooded with strong sunlight. If one stands with his back to the sun every leaf on a tree can be seen; the shape of each leaf can be defined although they may be the same colour. The reason is that leaves are not entirely flat; their edges turn in various directions so that certain portions intercept the sunlight rays and corresponding portions are shaded. It is this light and shade effect which gives shape, from a visual point of view, to the leaves. The stereoscopic effect of looking at an object with our two eyes also assists in giving the impression of shape, depth, and shade. Seen under diffused daylight, when the sun's rays are passing through clouds, the leaves appear flat, and no definite shape can be determined, except outlines through contrast between leaves, branches, and tree trunk. From this we must conclude that, for clear vision, the light must be directional and not too well diffused.

Three Different Types of Light Rays.

Although, if passing through a homogeneous medium, light rays travel in straight lines from a light source to an object, they may, relative to each other, be divergent, convergent, or parallel, it depends upon the distance of the source from the object. Fig. 1, A, B and C, illustrates divergent, convergent, and parallel rays. Light rays from the sun may be considered to be parallel, since the distance between the sun and the point where they are received (in our case, the earth) is so great.

A photograph illustrating the writer's point in connection with the difference in appearance between foliage as seen in direct sunlight and foliage as seen in diffused light (shade).

Divergent and convergent rays are illustrated in practice in Fig. 2. Here L is a light source situated a short distance from an object in the form of a cube. Three sides of the cube can be seen; A, B, and C respectively. The light rays, relatively to each other, from the source L to the cube, are divergent. From the cube to the eye they are convergent, because it is through reflected light from the cube that the latter is seen; a small pencil of light enters the eye.

The rays of light from an object to

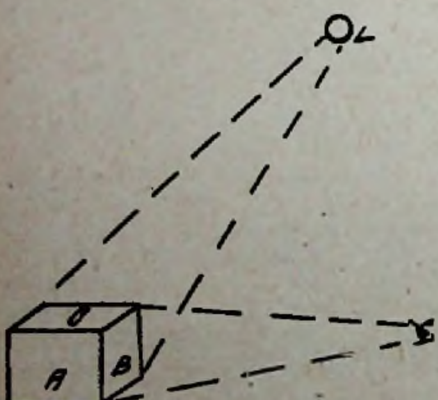


Fig. 2.
Illustrating divergent and convergent rays.

the television transmitter will be convergent; this because the area of a scene, say, the Derby, will be quite 200 square yards (I have assumed a distance of 40 yards long and 5 yards high); this will be concentrated for transmission purposes into an area considerably less than one square yard.

Light and Shade.

Fig. 2 is interesting from the fact that consideration of it will create a clear understanding of light and shade with artificial light sources. Assuming the light rays to be of constant value, round the source, in all directions, the illumination from sides C and B will depend upon the relative positions of the cube and L. If, for instance, L was situated immediately above the cube, the illumination from C would be very bright; as L is moved to the position shown in the illustration, a greater area of B is presented to it, so that more light is reflected from it. A, being furthest from the light source, receives practically no light.

In this way we get three intensities of light reflected from the cube into the eye: a high intensity from C, a lower intensity from B, and a much lower intensity from A. This variation in light and shade helps to give the object shape, since it can be seen in what is known as its three dimensions. When a scene is being transmitted, if the three dimensions can be clearly seen, then the reproduction on the televisor screen will be clear. Again we require the assistance of our *two* eyes in order to get a proper stereoscopic effect.

Difference in Colour Quality of Natural and Artificial Light.

I have said that there is a difference between the colour quality of natural and artificial light. This can be seen by consideration of the spectrum illustrated in Fig. 3. This shows a spectrum of normal daylight with relative band widths for this quality of light. The curve above the bands shows the apparent intensity (to our eye) of light from the various colours. It will be seen that the most intense light in the spectrum is yellow. The intensity falls very quickly towards the infra-red end and more gradually towards the ultra-violet end.

The phenomena of colour has been studied by many experts, but there still remains a vast unexplored unknown. From our point of view we have to remember that we are concerned with extreme contrasts, or correct contrasts, in light and shade. With the normal spectrum it is known that the whole of the colours, superimposed, produce white light, the correct light—if directional—to produce the proper effect of light and shade. With artificial light, however, it is much different.

Mercury vapour lamps, for instance, such as are used for illuminating settings in kinematograph studios, produce an illumination which is devoid of red rays—or practically so. This kind of lamp,

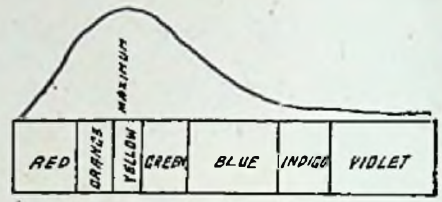


Fig. 3.
This diagram of the visible spectrum shows how yellow light produces the strongest impression on the human eye.

owing to its distribution powers, is suitable for kinema work. But, owing to the fact that the film must be produced in black and white, with the correct amount of light and shade, faces are painted yellow, eyes are shaded green and red, and dress shirts which must appear immaculately white on the screen are a glaring yellow.

The reason for this is that, since there are no red rays in the spectrum, the black and white effect must be produced by receiving the remainder of the colours on material which is not normal. It is the effect of coloured light upon colour. If we

Another photograph showing the difference in appearance of foliage in sunlight and in shade.

desire to broadcast, say, a play in a theatre, so that it will be received on a televisor screen, the lighting will have to be either artificial daylight, or it will have to be rectified at the transmitter, or receiver, or both.

(*To be continued.*)

WHEN ELECTRIC SIGHT COMES INTO BUSINESS

By S. R. MULLARD, M.B.E., A.M.I.E.E.

As spoken to Stanley B. Frederick.

READERS of the daily press, and particularly readers of your magazine, are familiar with the fact that certain things have been accomplished by the system of electric sight which is everywhere described as television. Each will recall very vividly to the mind that these accomplishments have inspired the admiration of the whole world.

Scientists were startled at the stupendous strides which have been made. They were surprised to see for themselves that electrified sight was not something for a future generation to invent, but that it was already developed by a contemporary inventor to a degree which enabled the easy recognition of a human face over the stretch of land which lies between London and Glasgow.

IN this special contribution to "Television" many interesting thoughts are put forward by Mr. Mullard. He visualises the day when enterprising business houses may make wide use of the power of television to promote business. The object of his remarks is to point out the great potentialities of a system which has the ability and penetrative power to make large business concerns larger.

Continued Progress.

Since that night when Frith Street became universally known, the press has carried news of further developments which convey their own story of continued progress towards the final achievement. One cannot forget the comments of the press upon the occasion of the transmission across the Atlantic in which the great liner *Berengaria* figured so prominently. Then we heard of television in daylight—a step soon to be followed by another—the transmission, reception, and reproduction of coloured objects by means of television apparatus invented by Mr. Baird.

Great progress has been made in this new science of extending electrically the range of vision of the human eye. Technically the difficulties were mountain high—insurmountable it would appear. Something has been done. Human sight is limited. Its limitations become more strongly registered as the power of broadcast speech and music extends.

Here is Mr. S. R. Mullard, a prominent figure in the radio industry and whose name will at once be associated with radio receiving valves.

As we know, it is now possible to hear the voices of our cousins overseas no less distinctly than those from the broadcast studio in our great city of London. Expensive equipment is not necessary at the receiving end—two valves are ample to bring in signals from Australia. A man speaking in Sydney may be heard in this country on a two-valve receiver. Any man in this country is able, as it were, to transport his ears over the vast continents and oceans intervening, providing, of course, that he is in possession of an aerial and a radio set of the type referred to.

Twenty-five Years Ago.

For this really prodigious achievement—now a commonplace and everyday happening—one gives the credit to the valve. Twenty-five years ago the idea of suggesting the reception of antipodean broadcast stations by an ordinary man with an ordinary set would have been treated with no small measure of scorn. But we know that it is an idea no longer. It has not been an idea for many years. The schoolboy is as skilful at tuning-in Australian stations as the more efficiently equipped commercial stations. In point of fact, one remembers instances where the amateur has rendered great service to the community by his reception of important signals where the commercial stations have not been successful. The co-operation of the amateur has been sought by the commercial stations from time to time.

Importance of Communications.

It all means that so far as the ear is concerned the dimension of space does not exist. Small wonder that we expect so much from the new science which is intended to accomplish for the eyes of man what radio has already done for the ears of the human race.

In war or peace the importance of communications is not to be depreciated. To the General the maintenance of communications is imperative to the good fortune of war. It is no less indispensable or exigent to the man of peace, who in his business activities finds the need for communication a matter governing largely the success of his affairs. Travellers are despatched to every market carrying samples. They make personal contact with potential customers. Enormous sums of money are allocated to the preparation of printed communications which carry illustrations and descriptions of goods. "Tell the world" is the business man's belief.

A "Sales Blanket."

Big business calls for communications extended into every corner of the world's markets. It demands, however, more than pioneer trails into the countries and towns where live customers. Successful trading dictates that communications should be maintained.

In this country we use the personal element to back up and to bring to fruition the message carried by printed communications. In America the monster trading concerns employ the great invention of radio. Every night they make contact with the consumer "over the air." The sales-creating communications are put out "on the air." One million people hear a brand name—on the same evening, at the same moment.

Broadcasting Used Extensively.

It is a thought for the man at the head of a large business. Radio, in the view of the commercial houses operating in the New World, is a means of communication. It is used by them extensively and most American corporations with experience of its power to create and maintain trade are insistent to continue its employment. By such an attitude towards it one concludes that as a commercial investment a radio station is a very valuable link between manufacturer and consumer, not only from the angle of propaganda itself, but also from that of sales; for one hears that the number of manufacturers utilising radio stations would increase were it possible to find space for more transmissions over the wave-band allotted to the United States.

Radio an Aid to Business.

This so-called waiting list is doomed apparently to a prolonged wait, not altogether for the reason given, but for the more interesting fact that once having tasted of the great power of radio as an aid to business the commercial magnates of America are not anxious to part with their concessions. The few kilocycles granted to them become increasingly valuable as the demand for space on the air increases, and one is able to understand why there are very few who hand back broadcasting rights to the authorities. Records show that demissions of this type are surprisingly low in number—almost small enough to warrant the statement that the concession obtained is zealously retained. On the face of it, one registers the thought that radio as a means of creating sales is extremely profitable.

ON this page we read: "One may be assured that its possibilities have already been thoroughly surveyed and that at such time as its services become available we shall hear of many interesting applications of the science of electric sight to selling . . . the scope of the manufacturer will be widened to a degree which almost approaches the phantasmagoric."

The Business Man's Viewpoint.

In this country, of course, manufacturers are not in the position to adopt this system, in favour of which there is much to be said from the business man's viewpoint. That there is also something to be said against it need not be emphasised, as the pro and con of the argument has appeared in the press from time to time.

For the present, at any rate, British manufacturers are not in the position either to erect their own radio transmitting station or to lease one belonging to another organisation.

One's views are obtained from the observation of the service active in the U.S.A., and speaking from the limited angle of a manufacturer it would appear that there is much to be desired in their system, although good business suggests that the greatest good comes out of service to the greatest number. Let this be the interest to be followed. To what use shall we, as men of business, put television?

The Penetrating Power of Radio.

We have seen America add the penetrating power of radio to its selling activities. It is true that its power is not employed blatantly or inartistically. Rather to the contrary, as it happens. The American manufacturer is to be commended upon his highly-developed sense of possible consumer opposition to crude selling on the air. One phrase, perhaps, in an entire programme of an hour alone indicates the organisation behind the broadcast. It is apparently sufficient to put the story over.

How will these same manufacturers make use of television, as there is every reason to suppose they are certain to do if their attitude towards radio is to be considered a true indication of their opinion concerning the employment of modern inventions as a profitable means of selling?

To suggest that they would pass over its claims is not in conformity with the known characteristics of American business men. One may be assured that its possibilities have already been thoroughly surveyed and that at such time as its services do become available we shall hear of many interesting applications of the science of electric sight to selling.

The Commercial Application.

When such progress has been made the scope of the manufacturer will be widened to a degree which almost approaches the phantasmagoric. It is not difficult to foreshadow the course to be adopted by the manufacturer who in time to come will employ the power of transported sight.

It is apparent that its greatest utility will be to give owners of a television receiver a reproduction of any product in which the manufacturer controlling the transmission station is interested. Although television will be able to show the head of a manufacturing concern actually handling his product—demonstrating it, as it were, to the millions who are "seeing-in"—we need not fear that such penetration into the homes of the people will be abused by blatant advertising. One feels very sure that the situation will provide an opportunity for the playwright and his associate —the producer. This thought takes us perhaps far into the future.

A Practical Suggestion.

Be that as it may with progress, by which one means the improvement of the present apparatus so that fairly comprehensive scenes may be the subject of the transmission, it is quite within realisation that the expert producer may turn his attentions to attain skill in the infusion of unobtrusive selling effort into playlets constructed with the object of illustrating the merits of this or that particular product. Just as the playwright may see his play made or marred by good or poor production—that is, by the cleverness or otherwise of the producer—so will the manufacturer televising a scene intended to demonstrate the distinctions of his products also find himself in the hands of such an individual.

One is able to visualise the opportunity such possibilities will provide the skilled demonstrator. He or she, depending naturally on the actual product forming the subject of the television broadcast, will be seen by everyone with a television receiving apparatus. **Thus we see that the uses of television to trade may, under certain conditions, provide the chance for manufacturers actually to demonstrate personally their products to the thousands who see-in.** That such a development is far distant or otherwise it is not possible to suggest. Whether or no it will be possible in this country is also a thing shrouded by the future.

Familiarising Product and Carton.

At any rate, whenever it is possible there is every reason to suggest that our friends across the Atlantic will take advantage of it, providing, of course, that their present policy in regard to radio is also adopted when the question of television arises.

Should it be possible for a manufacturer to broadcast a televised reproduction of his goods, great strides will be made by making the physical appearance of those goods familiar to the public. Colour television will enable the products to be reproduced in the homes of the people in their natural colours. Product recognition is one of the chief aims of a good selling campaign. The ability to broadcast the appearance of the product and the carton in which it is packed will do great things; the facility to demonstrate its utility will do greater things; a business man's peep into the future. . . .

Proficient demonstration will figure as largely as talented sales-talk, as one presupposes that speech would synchronise with the continued movement of the picture. However, for the most part we should be concerned with "close-ups," as the film producer describes the process of enlarging one particular portion of a scene.

> **MR. MULLARD, who is the Managing Director of the Mullard Wireless Service Co., Ltd., the manufacturers of the Mullard radio valve, speaks with authority and experience on business, the successful promotion of which entitles him to be described as a captain of industry. He says on this page:**
>
> **"The ability to broadcast the appearance of the product and the carton in which it is packed will do great things . . . the facility to demonstrate its utility will do greater things."**

Just as manufacturers make use of radio to communicate with business associates, it is also possible that at some future date regular communication will be maintained by television between one company and another or between a head office and its branches, and so on. Samples of new lines, where it is now necessary to despatch by mail or boat in order for them to be examined even superficially, will in the future, when we have television, be placed before a television transmitter. The general appearance of a product will then be seen at the other end.

Much time would be saved by such a system, especially if the interested party was resident, say, in Australia or America. Even at shorter distances the practicability of such transported sight would prove of considerable assistance in bringing a business deal nearer completion. A "close-up" of a radio valve showing its electrodes, together with the characteristic curves, for example, would be sufficient to impress a potential customer. Synchronised speech would enable a deal to be completed over a distance which would only be limited by the radiating power of the transmitter and the receiving range of the receiver.

Immense Potentialities.

It is clear that the potentialities of television are immense in the world of business. The idea is interesting as its introduction would involve the recasting of many orthodox methods of selling. Competition would become stronger as the buying public could be made equally familiar with competitive products—a state of affairs which does not always exist to-day. It would probably result in the manufacturer with the best product obtaining his merited share of the market. It might follow that the company which could not afford the employment of the system would be gradually forgotten as its wealthier competitors adopted the system more and more.

Even in its more limited application as an inter-company or inter-branch method of communication, the possibilities of television are no less striking. **The spoils will go to the manufacturer who chooses to utilise the most modern method of communication. Every progressive business man awaits developments with an interested mind.**

Effect on the Public.

In the foregoing remarks, of course, the possibilities of television have been visualised from the standpoint of the manufacturer and the business man. So far as the public itself is concerned much could be said which would make interesting, informative and, at the same time, instructive reading, as it will be realised that the service to the community as a whole to be rendered in the future by television will probably follow the general line of development which radio has taken—in that some regular service will be instituted, designed to entertain at the touch of a switch.

THE STEREOSCOPIC TELEVISOR

By DENISON A. VERNE

IN this article the mechanism is explained by means of which stereoscopic television is accomplished. A close examination will reveal that the essential parts of the apparatus resemble those employed for ordinary television and colour television, the greatest difference being that at the transmitter two spot lights are employed.

There is no doubt that one of the outstanding characteristics of the human race is its natural propensity for taking things for granted; of settling down in a comfortable and uninquiring manner, most beautiful in its unswerving faith, to the interpretation of the warnings, proddings and general everyday communications of some five or six senses, without really bothering to observe if there is any particular reason for a noise appearing to come from the direction of its origin, or that the moon should seem farther away than the sixpence which just covers it. "Ah, yes," the layman says, in preoccupied detachment, "let Newton, Darwin, Faraday, Clerk-Maxwell, and Hertz spend their lives in realms of nice intellectual discrimination: these points, though interesting, are not of vast moment to me!"

Layman's Interest in Science.

While not disputing the implied truth of this, in so far as these Masters are far more capable of intuitive conception, concise thought, and exact statement than the average muddled brain, I should like to point out to John Smith that it would be a matter of no small moment to him if he were incapable of stretching out his hand for a glass of sherry without spilling it woefully, or of attempting to pick a rose without thrusting his fingers against a dozen thorns; and such would assuredly be the case, but for the fortunate circumstance that he has two eyes and not one.

The essential truth of this may be simply demonstrated. Look out

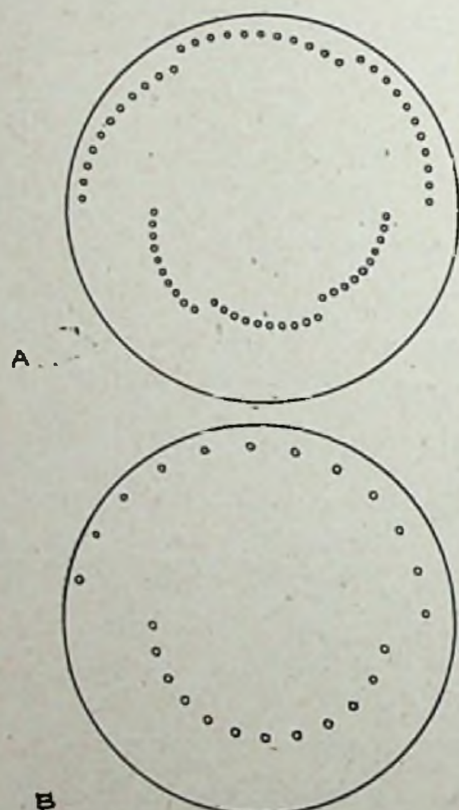


FIG. 1

Disc perforated as shown in Fig. 1B for monochromatic representations or as in 1A for three-colour transmission, the slots being covered with light filters.

of the window at a group of objects between, say, twenty and fifty yards away. The nearer units of the group appear unmistakably nearer, and it would probably not be difficult for the observer to form some rough idea of the positions of the elements of the group in terms of a preconceived length unit. On shutting one eye, however, it would be impossible for the observer to form any such estimate without relying on previous or subconscious knowledge.

A single eye sees most distinctly any point on its optical axis, and less distinctly other points also, towards which it is not directly looking, but which are still within its circle of vision. It is able to judge of the direction of such a point but unable by itself to estimate its distance. When the two eyes are directed upon a single point, we then gain the power of judging its distance compared with any other point, and this we seem to gain by the sense of greater or less effort required in causing the optical axes of the eyes to converge upon the one point or upon the other.

Sensation of Distance.

Now a solid object may be regarded as composed of points which are at different distances from the eyes. Hence, in looking at such an object, the axes of the two eyes are rapidly and insensibly varying their angle of convergence, and we as rapidly are gaining experience of the distance of the various points of which the object is composed, or, in other words, an assurance of its solidity.

Let any solid object, such as a small box, be supposed to be held at some short distance in front of the two eyes. On whatever point of it they are fixed they will see that point the most distinctly, and other points more or less clearly. But it is evident that, as the two eyes see from different points of view, there will be formed in the right eye a picture of the object different from that obtained by the left; and it is by the apparent union of these two dissimilar pictures that we see the object in relief. If, therefore, we delineate the object, first as seen from the position of the right eye, and then from that of the left, and afterwards present these dissimilar pictures again to the eyes, taking care to present to each eye that view which it would normally see, there would seem to be no reason why we should not see a representation of the object, as we saw the object itself, in relief. Experiment confirms this supposition.

The latest advance in Television is the production of television images in stereoscopic relief, which was demonstrated on August 9th by Mr. Baird to the Press, and also to

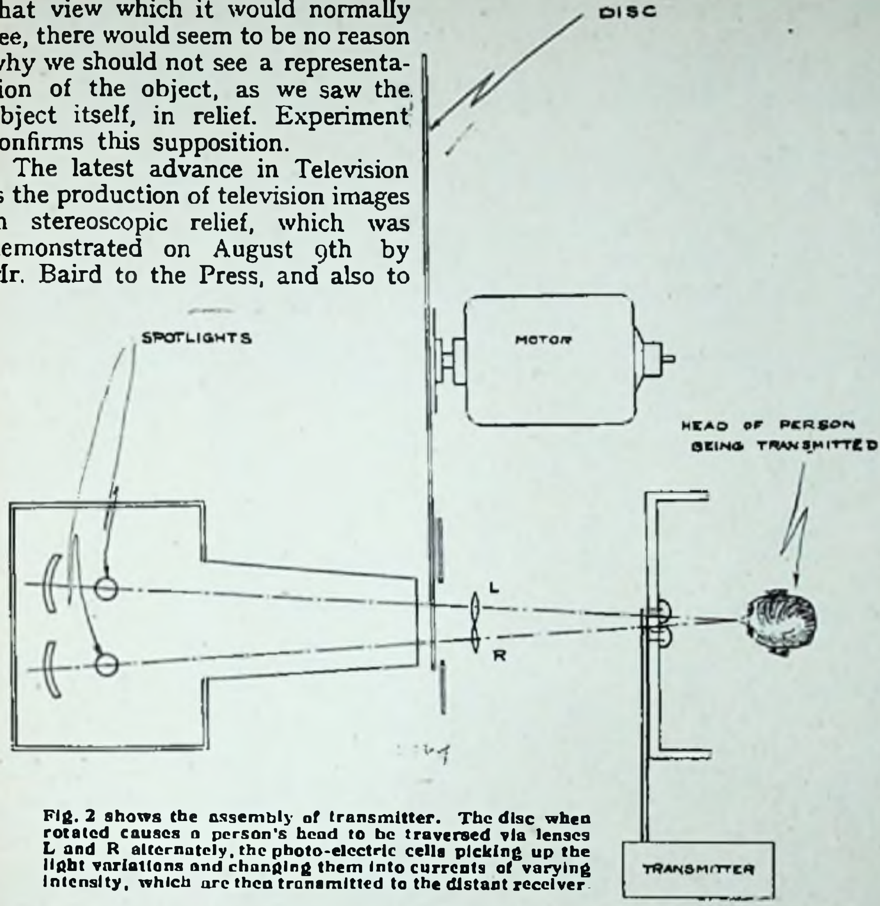


Fig. 2 shows the assembly of transmitter. The disc when rotated causes a person's head to be traversed via lenses L and R alternately, the photo-electric cells picking up the light variations and changing them into currents of varying intensity, which are then transmitted to the distant receiver.

a number of scientists, a demonstration at which I had also the privilege of being present.

The transmitting apparatus consists essentially of a disc perforated with two sets of holes arranged in spirals. The arrangement is shown in Fig. 1. Through these perforations are projected pencils of light from a spotlight lamp, the pencils of light scanning the object to be transmitted through the lenses marked L and R in the diagram, Fig. 2. In this way the object is completely traversed alternately from two positions, one a little to the right of the normal to the surface, and the other a little to the left of the normal.

The Transmitter.

The rays are reflected back, and to a certain extent diffused, the intensity of this reflected light causing corresponding variations in the resistance of a photo-electric cell, which in turn controls the current passing through it. This undulatory current is transmitted to a distant receiving station, where it is used to vary the light emitted by a neon tube behind an exactly similar disc which revolves synchronously with that at the transmitting station.

The arrangement of the receiver is shown in Fig. 3.

The two images formed by side side on the receiving disc are viewed

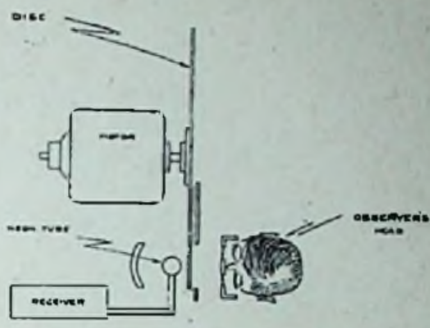
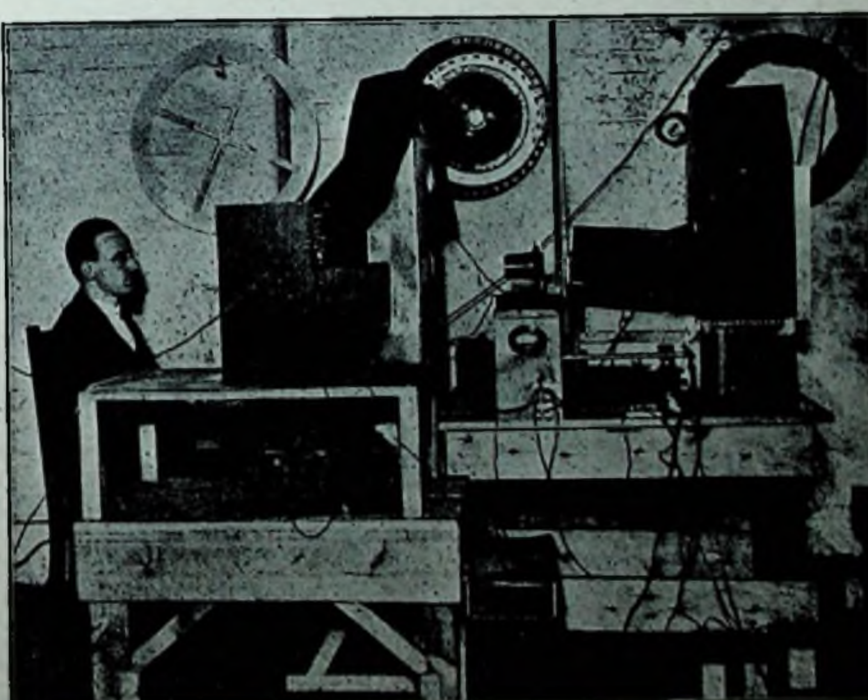


FIG 3

Fig. 3.—The observer looks through a stereoscope at a disc similar to that at the transmitter, while the light of a neon tube behind the disc is modulated by the incoming signals. Two images are formed, which are merged by the eyes, giving one representation of the object in stereoscopic relief. For colour stereoscopic television red, green and blue images are transmitted and received successively, the combined effect on the retina being that of one image in natural colours.

through a stereoscopic viewing arrangement consisting of two prismatic lenses which cause the two images to be superimposed and merged into one, giving an impression of solidity to the received picture, so that an object seen appears not as a picture on a screen, but as if one were looking at an actual solid object.



This illustration gives a very excellent idea of the compactness of the latest type of Baird television transmitter adapted for stereoscopic television.

An Improved Electrolytic Rectifier

By CEDRIC W. MARSHALL

This article describes an inexpensive chemical rectifier which has the merit of being easily constructed. The chief distinction of the arrangement is the elimination of the centre-tapped transformer.

ONE of the problems with which all wireless experimenters and broadcast listeners are faced is that of providing an adequate supply of high-tension current for the plates of valves. Dry batteries, although convenient in many ways, suffer from many disadvantages and require frequent renewal at considerable expense.

One solution of the difficulty lies in the direction of the installation of high-tension accumulators. Such a source of high tension has a considerably longer life than a dry H.T. battery, but accumulators require frequent recharging. Where the user has electric light laid on to his house he is in the fortunate position of being able to do his own recharging without being put to the inconvenience of carrying a heavy and bulky battery to a charging station, and being without it during the period of time required to charge it.

A Three-Electrode Rectifier.

If the source of home supply is in the form of direct current there is little difficulty in rigging up a charging system for the high-tension batteries, but if the power supply is in the form of alternating current this must first be rectified into direct current before charging can be effected. Many rectifiers of varying types have been devised from time to time, and a very representative type is known as the chemical rectifier.

The chemical rectifier itself has undergone many changes and modifications within the last few years, and it is proposed in this article to describe how the three-electrode chemical rectifier, which replaced the old four- and three-cell types, is capable of a further modification which may not be generally known, and which enables an efficient apparatus of this kind to be made from scrap material and simple parts which may be purchased at a total approximate cost of 7*s.* 6*d*.

The chief merit of the new arrangement is that it is possible to do away with the hitherto necessary and expensive transformer with central tapping. In place of the later the present design makes use of two balanced inductances, which may conveniently take the form of two carbon filament lamps. By adapting

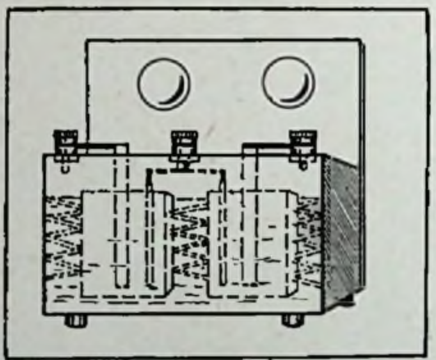


Fig. 1.
Side view of the completed apparatus, showing how the jars are packed into the tin- or lead-lined container by means of zig-zag lead strips.

the voltages of the lamps various supply mains may be catered for—e.g., two 150-volt, 25 cp. lamps placed across the two halves of the three electrode aluminium cell on a 200-volt circuit gives a fully rectified direct current of 90 volts, 1 ampere.

By inserting lamps of various voltages the output D.C. may be varied from 0 to 200 volts. The arrangement indicated in the accompanying diagrams, however, is the best for charging high-tension accumulators, the purpose for which the rectifier seems to be most fitted.

To make this rectifier the first requirements is a wooden case, measuring about 7 in. high by 7 in. deep and 9 in. long. This case must be fitted with a watertight tin or lead lining, which just fits the inside. Two small jam jars are then packed in the case, being wedged by means of a lead strip, bent in zig-zag fashion.

The Shape of the Cathode.

Procure a pair of lamp sockets for panel mounting, and screw them evenly on a piece of wood measuring 2 in. by 9 in. and fix this piece of wood to the top of the container, as shown in Fig. 1. A similar piece of wood carrying three terminals is then fixed across the top of the case, as shown in Fig. 2.

The anodes of the rectifier consist of aluminium rods which are pushed through the holes in this panel, so that a length extends well into each jar. The tops of the rods are connected to the adjacent terminals by short lengths of wire. The single cathode is a U-shaped lead strip, the bottom of the U being fastened to the central terminal, so that each limb lies in a cell.

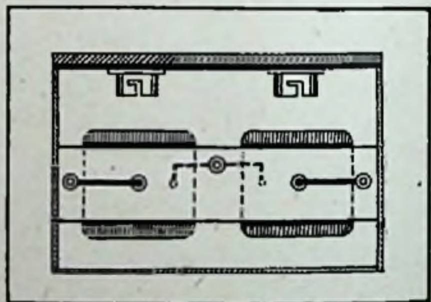


Fig. 2.
Showing the arrangement of lamp sockets and terminals.

In wiring up the lamp sockets and cells are connected in parallel with the A.C. input, the output D.C. terminals being the cathode terminal (which is positive) and a point between the lamp sockets (which is negative).

(*Continued on page* 28.)

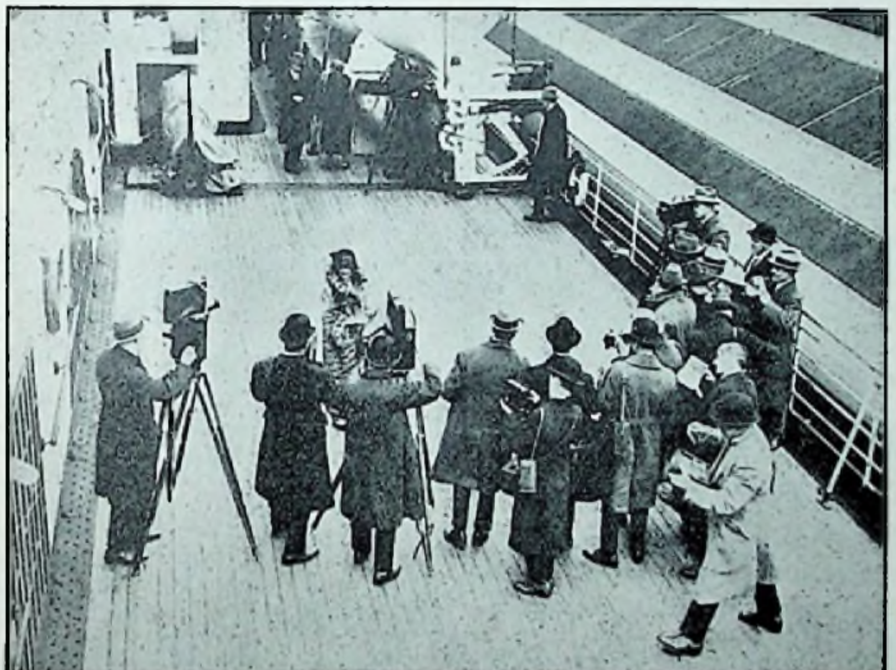
TELEVISION AND THE FILMS

A Talk with Leading Film Producers

By SHAW DESMOND

Author of "Passion," "Bodies and Souls," "Gods," etc. etc.

In the following article, specially written for "Television," the famous Novelist, Journalist, Lecturer, and Politician Mr. Shaw Desmond gives us a glimpse into the film of the future and draws a vivid pen-picture of the wonders and almost unlimited possibilities of Television.



The above picture shows a group of modern cinematographers at work. In time to come (probably not so far distant, either) we shall see men with a television transmitter of, probably, somewhat similar bulk busy "shooting" scenes direct on to thousands of home and public televisor screens all over the country.

TELEVISION is the magician of the future. Television is going to give us picture-magic. Television is now to make the dead bones of the films "rise up and walk." It is about to give us new worlds for old!

The pictures are on the threshold of a revolution quite unguessed at by the picture fan.

Thomas Edison said to me a little time ago in his laboratory in West Orange that the world was on the eve of momentous happenings through the newly-invented "power-projection" through the air, from the control of pilotless aeroplanes from the ground and the explosion of ammunition dumps at any distance to the finer and more delicate projections of "wireless," especially as regards the living picture. It is in the fairyland of the pictures of the future that wireless plus television will play a decisive rôle.

"To this power of projection there are no limits," said the famous inventor, who is notoriously conservative in his statements.

Already by wireless waves we are able to see the man with whom we speak upon the new "television-telephone." And, as we know, there is now in existence a method by which the dummy figures of the film become alive through the spoken word, their movements and speech being made as visible and as audible to the audience as those of the ordinary actor, synchronising.

I have reason to think, also, that we shall soon see the figures "come out of the screen," as in the old-fashioned stereoscope. When that day comes the theatre proper will be directly challenged.

Personally, I do not believe that, ultimately, the dummy of the picture, even when he walks and talks like a living man, can ever be other than a sublimated robot. The theatre proper will always have its arena, one in which it cannot be challenged. No robot can compete finally with flesh and blood. But what about flesh and blood taken *direct from life* and seen through the televisor?

Films "from Life."

There is no evidence yet of a "revolt against the robot," as seen in the films. But there *is* evidence of a revolt against the "dummy"—that is, a demand for the "character" film as opposed to the film of the pretty face. The present movie stars of the glassy smile and lips painted like pieces of butcher's meat may before long, like Othello, find their occupation gone. The woman "character" actor will remain. People like Wallace Beery, Vera Gordon, Jean Hersholt and Farrell McDonald are to be exalted, whilst that great Austrian, Emil

Jannings, if he be not destroyed by the American process of "capitalising talent," may be taken as the type of the future. All this is paving the way for the television-film "taken from life" itself.

There are, through this new trend, to be many radical changes in the studios, many heartburnings and many jealousies, though that day is not yet. And Hollywood is going!

Two of the greatest living producers, including Mr. M. A. Wetherell, are in agreement with me that, with the coming of the "character" film, even before the advent of the television-film, of the Charles Dickens type, we are going to see the novelist proper pressed into the service of the pictures to write the "captions." As novelist, I am interested naturally in this, and know of others who, like myself, have been approached by film companies for this purpose.

The Trend of Things.

"Captions, hitherto, have often been crude and ill-informed," said a prominent London producer to me recently in the intervals of making a new war film, "sometimes shocking the onlooker by their exaggeration and lack of continuity. The trained novelist, and especially the coming of television-films, will change all that.

Producers of the first rank, with princely salaries (some of them with salaries varying from £5,000 to £15,000 per annum) who are, I understand, in agreement with the view that economy in word and action is the thing at which the future film will aim.

One first rank producer, Mr. Alfred Hitchcock (who is only 27), says: "What we must strive for at once is the way to use these film nouns and verbs as cunningly as do the great novelist and the great dramatist, to achieve certain effects on the audience." The "direct life-film" will demand this.

This trend away from the "pretty-pretty" and the saccharine offerings of the worst of the American films is going to make a road for both the "shadow-pantomime" and for the educational film.

The Shadow Film.

The famous German film, perhaps one of the half-dozen greatest films ever shown, called "Warning Shadows," which showed at the London Tivoli, is but the pioneer of a series of similar films. Shadow-sending by television is remarkably easy.

"The shadow-pantomime," as I have called it, that is the whole film going forward in a series of shadow-pictures without words, will always have to depend chiefly upon a "selective" audience, but the Germans are now preparing a series of such pictures, though, of course, without the televisor.

We reproduce above a photograph of the Author whose contributions to this magazine are very popular features. In the article printed here Mr. Shaw Desmond's remarks on the film are succinct and pithy.

The grown-up often loves shadow-pictures. We are all like children in this. The kiddies usually prefer a shadow to a "straight" picture. For the "shadow" offers possibilities of "suggestion," and by "leaving it to the imagination" gets effects not possible to the straight film. A television shadow-film, *showing the play as it was acted*, would fill any theatre!

Now we come to what is the most important of all film evolution—the Kiddies' Picture-Theatre.

I am convinced that the education of the future will use the picture rather than the book. The picture which I saw of the ways and habits of the lobster, taken in its natural surroundings, will teach a child more in one hour about natural history than half a year of natural history books.

Experiments recently made showed that of children taught a certain subject by the book, less than 30 per cent. passed an examination in that subject. Of children of the same age taught the same subject by "the movies," 90 per cent. got through.

We shall see, in the not distant future, educational picture-theatres established in the great cities, seating anything from two to five thousand children, and showing lobsters, lions and men as they are living "at the moment of showing." The London County Council may one day use such theatres for its extension lectures, as may other similar institutions. I pioneered this suggestion long years before the war, before television was heard of, but it may not take even another five years before we see it in action, *plus* television.

Momentous Events.

The educational side of the future film will be much helped by the coming of the music-picture. Here, we are on the edge of momentous events.

Already, as I have said, by "wireless waves," we are able to see the man with whom we speak upon the new "television-telephone" by utilising the translation of light into sight. Now we are about to see the translation of light into sound.

"The film of the future will carry its own incidental music *in the film itself*," said the men who made the "Robinson Crusoe" picture, to me. This will avoid those painful "cuttings off" when the music has not kept pace with the screen. The music will be actually in the screen, the light waves being converted into sound, and I believe that some such method has already been demonstrated in London.

"Music in Colours."

We have now gone a step further—that is, *the conversion of sound into colour*.

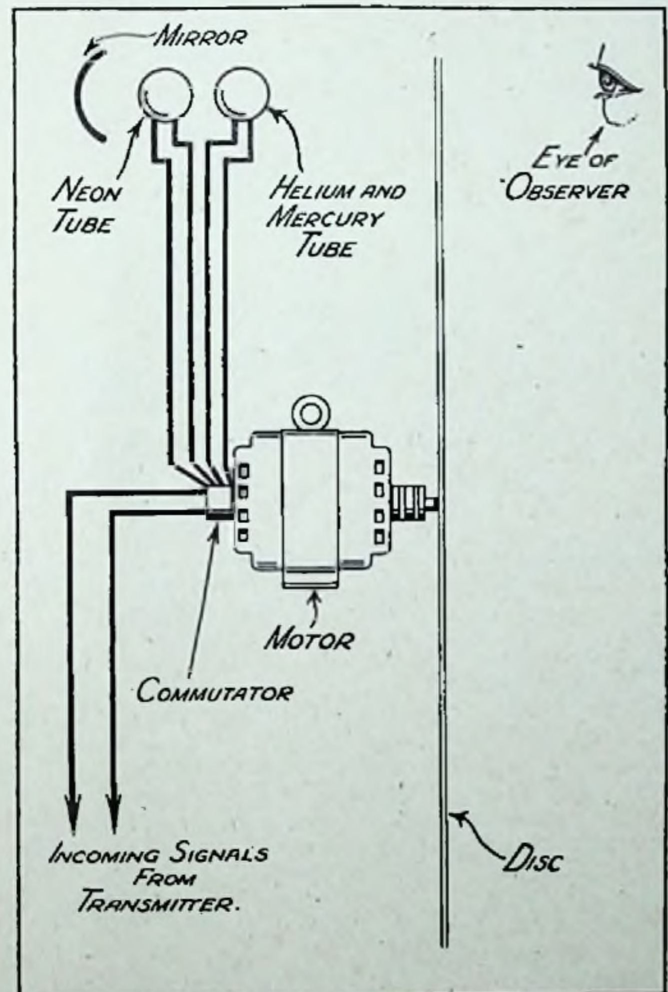
This I recently saw demonstrated in Philadelphia by the inventor, Thomas Wilfred, in combination with the famous Philadelphia Orchestra. It was just "music in colours."

Leopold Stokowski, one of the first living conductors, in helping at this demonstration, said: "These music-pictures may in time lead to new combinations of form and rhythm which have hitherto only been the dreams of a few great spirits."

(Concluded col. 3, opposite page.)

HOW COLOUR TELEVISION IMAGES ARE OBTAINED

When the red spiral of holes in the transmitter disc is passing through the exploring light spot it is arranged that the eye of the observer at the receiver shall also be looking through the red spiral at the receiver, and by means of the commutator shown it is arranged that during that period of time the incoming electrical impulses from the transmitter shall feed to the neon tube, thus producing a red light.



The disc shown above carries three spirals of holes, each set of holes being covered with a colour filter. Thus, one spiral passes red light, the second green, and the third blue, as described and illustrated in our August issue. The neon tube shown above is the source of red light at the receiver ; the helium and mercury tube provides the green and blue light.

Red parts of the object being transmitted are thus seen in their natural colour by the observer at the receiver. Differently coloured objects produce little or no effect until the blue or green spirals come into operation, automatically switching into circuit the helium and mercury tube instead of the neon tube. Blue parts of the object show up blue at the receiver when the blue spiral is operating, and green parts are reproduced green when the green spiral is before the eye of the observer.

Combination colours are reproduced by the combined effect of the different coloured spirals and light sources.

(Concluded from opposite page.)

To watch upon the screen, as the orchestra played, the folding and unfolding of fairy scenes of colour and the painting by fairy hands of pictures actually expressing the music, was a new revealing of the possibilities of the "pictures."

The "automatic film" has already passed from the realm of phantasy to that of fact. Here, indeed, is an unexploited field for the educational film, helped by television.

Peeps at Mars and Venus.

Such films will be placed in the midst of the jungle to register the ways of the Wild Things that live therein. They will be "set" under water to tell us the life story of the man-eating shark and the great whales and the terrible decapod, with its ten waving tentacles, which haunts the sea-abysses. A way to overcome water-pressure and darkness is already being experimented with.

What the film of the future will do is to destroy the mystery of old earth by making all parts of it accessible to everybody—some day, as one thinks, without leaving one's own fireside. But this very passing of earthly mystery will drive man, the inquisitive animal, to realms outside the world. It will, I venture to prophesy, soon begin to be suspected that if "etheric wireless" ever passes the stage of experiment we may be able to picture the doings upon Mars or Venus and even to decide once and for all whether they are inhabited, as many astronomers contend.

But this is something yet to be realised. Almost all the other developments suggested are already passing or have passed from experiment to fruition, partly thanks to television.

"The pictures" are yet but babies learning to take their first steps.

Moving Shadowgraph Experiments in America

In America an enormous amount of interest is being taken in Television, and many experimenters are now devoting their attention to the subject. In the following article a description is given of a moving shadowgraph apparatus which has been developed by Mr. C. Francis Jenkins, who has interested himself in the subject for many years. The apparatus described, however, does not permit of the achievement of Television; it transmits and receives only the shadows of simple moving objects.

ONE of the best known experimenters in America who has been striving for some years to achieve television is Mr. C. Francis Jenkins, of Washington, D.C., who claims to be the inventor of the prototype of the modern cinema projector.

Before attempting to solve the television problem Mr. Jenkins experimented over a considerable period with photo-telegraphy apparatus, in conjunction with Mr. D. MacFarlane Moore, who has done a great deal of work in connection with neon tubes.

In the course of his experiments Mr. Jenkins produced an entirely new contribution to optical science, which is now known as the Jenkins Prismatic Disc. This disc consists of a circular plate of glass, the edge of which is ground to the shape of a prism, the angle of which varies continuously and gradually round the circumference of the disc. By using combinations of two or four of these discs, and rotating them by means of electric motors, Jenkins was able to explore a picture by means of a beam of light, which was caused to bend to and fro by virtue of the combined action of the rotating prismatic discs.

Fifteen per Second.

Finding this apparatus unsuitable for television purposes, Jenkins turned his attention to lens discs, and in the latest type of Jenkins machine, particulars of which are available, the lens disc carries forty-eight lenses, and the purpose of the apparatus is avowedly to transmit and receive, not television, but special cinematograph films. Using a wavelength of 300 metres, Mr. Jenkins has recently been broadcasting these special shadow films from his laboratory in Washington. There is no detail in the films, only a plain black and white silhouette of simple scenes such as a little girl bouncing a ball.

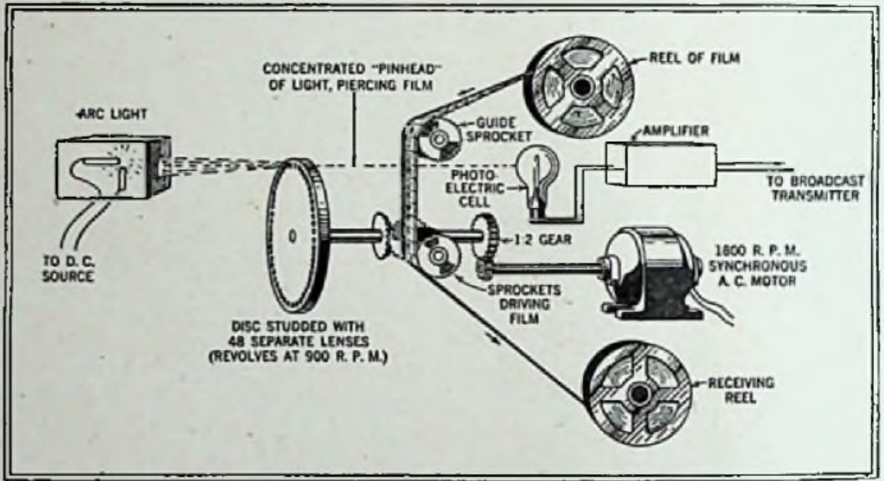


Fig. 1.
The general arrangement of the transmitter.

The films are reeled off through the transmitter at the rate of fifteen pictures per second—one less than the ordinary cinematograph. They are reproduced at the receiver at the same rate, and the received images, viewed through a magnifying glass, appear to be about six inches square. According to witnesses' reports, the received shadowgraphs are very clear, and the illusion of motion is excellent.

The Mechanical System.

The general layout of the new Jenkins animated shadowgraph transmitter is shown in Fig. 1. The film reels are mounted on a simple framework, one above the other, in such a manner that the film is pulled downwards by a set of sprockets which are driven by an electric motor. One end of the shaft which drives the sprockets is fitted with a gear pinion which meshes with another smaller one. The small pinion is mounted directly on the shaft of the electric motor, which is a synchronous A.C. motor capable of running at 1800 R.P.M. Because of the speed reducing action of the gears, the pictures are pulled past the sprockets, or any fixed point next to the film, at the rate of 900 per minute, or 15 per second.

The Function of the Lenses.

At the other end of the shaft which drives the sprockets is a heavy metal disc, about 15 inches in diameter and about one inch thick. The edge of this disc is studded with forty-eight separate little lenses, each of which has an "optical speed" of *f*. 3.5. These lenses are designed to concentrate the light from a powerful arc lamp into an intensely brilliant "pinhead" beam, which is caused to pierce the film as the latter travels down past the back of the disc.

Immediately behind the film is mounted a photo-electric cell, which is so placed that the "pinhead" beam of light, after passing through the film, impinges upon it. The cell is connected to a three-stage resistance-coupled amplifier, the output of which is connected to a further amplifier of similar design but having eight stages. Both amplifiers are very heavily screened by double copper shields.

A close study of Fig. 1 will make the operation of the apparatus clear. The lens dics revolve at 900 R.P.M., or fifteen times per second. The separation between the centres of the lenses is just equal to the width of the film. The latter moves steadily downwards at the rate of fifteen pictures per second. Its action is not jerky, as in a cinematograph projector.

Exploring the Picture.

The arc lamp on the left projects a powerful converging beam of light through one of the lenses of the disc, which lens further converges the beam to a point which "scans" or travels across the film from one side to the other due to the rotary motion of the disc. When the next lens picks up the beam from the arc lamp the film has moved downwards slightly, so that the second beam travels across the film on a parallel but slightly higher path. Succeeding lenses of the disc trace further parallel paths across the film, until each picture has been explored by the forty-eight lenses. As soon as the beam of light from one lens runs off the film, the beam from the succeeding lens starts to pierce the film on the other side. This movement is continuous during the operation of the mechanism.

Thus forty-eight separate beams of light travel across each individual picture in one fifteenth of a second. At the start of each fifteenth of a second period, a fresh picture slides into position and another series of forty-eight light beams start to pierce it.

While this movement is taking place the light beams, after shining through the film, fall on the photo-electric cell with degrees of intensity which depend upon the density of the parts of the film through which they shine. The electrical output of the photo-electric cell varies in proportion to the variation of the light intensity, and, after amplification, this varying current is caused to modulate the radio broadcast transmitter.

The Light Conductors.

The apparatus for receiving these transmissions has many points of difference from any other form of receiver previously described in this magazine. It is illustrated in Fig. 2, and consists of six essential parts. The heaviest unit is a 3,600 R.P.M. synchronous A.C. Motor, to the shaft of which is attached a hollow metal drum about seven inches in diameter and about five inches wide. The centre of this drum is a hollow spindle with a thin wall.

In corresponding places on the drum and the spindle are four spiral rows of tiny holes, twelve holes to a row. A short piece of quartz rod between the outside and inside connects each pair of corresponding holes. The purpose of the forty-eight little quartz rods is to conduct light from the inner spindle to the holes in the outer drum with as little loss as possible.

Fixed inside the hollow spindle, with the flat little plates facing directly outward, is a special neon tube having four discharge electrodes. This tube is about four inches long and one inch in diameter, the little discharge electrodes, or plates, being about one quarter of an inch square. A straight wire running near the four electrodes acts as a common element. In Fig. 2 this tube is shown withdrawn from the spindle, in order to illustrate it; in actual use it fits inside the latter without touching it.

The Output Connections.

The other end of the motor shaft is fitted with 1.4 reducing gear which drives a revolving switch. The revolving element is simply a pair of contact brushes connected together. One brush effects continuous electrical connection with a solid brass ring embedded in an insulating disc, while the other makes a wiping contact over the four sections of a split ring.

The four segments are connected to the four discharge electrodes of the neon tube, while the solid ring is connected to one of the output terminals of the radio receiver. The common element of the neon tube is connected to the other output terminal of the wireless receiver.

Picking-up the Signals.

All the receiving apparatus described so far is contained in a wooden box measuring about two feet long and a foot square at the end. Directly above the top of the revolving drum is a square opening in the top of the cabinet, and over this opening an ordinary mirror is mounted at an angle of 45 degrees to the top. About a foot in front of the mirror, and standing upright, is a magnifying lens about ten inches in diameter.

Following the action of the receiver, the modulated picture signals from the distant transmitter are picked up by an ordinary wireless receiver, amplified, and fed to the moving picture receiver. Assuming that the

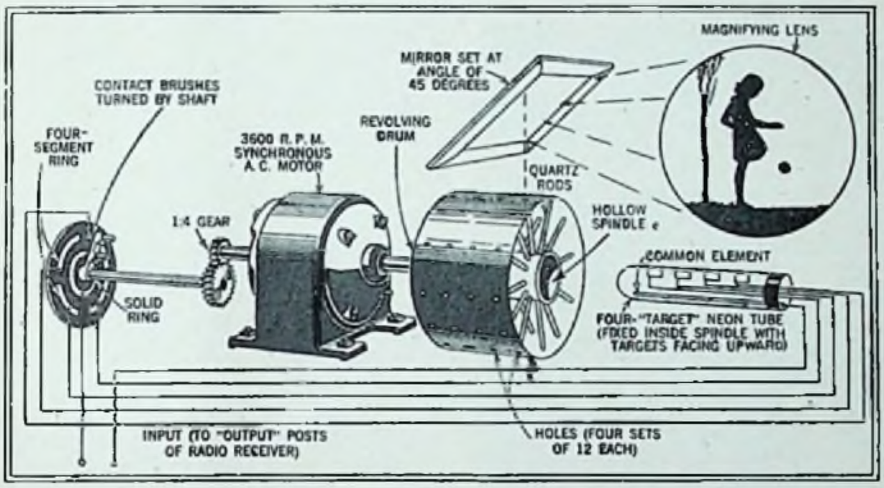


Fig. 2.

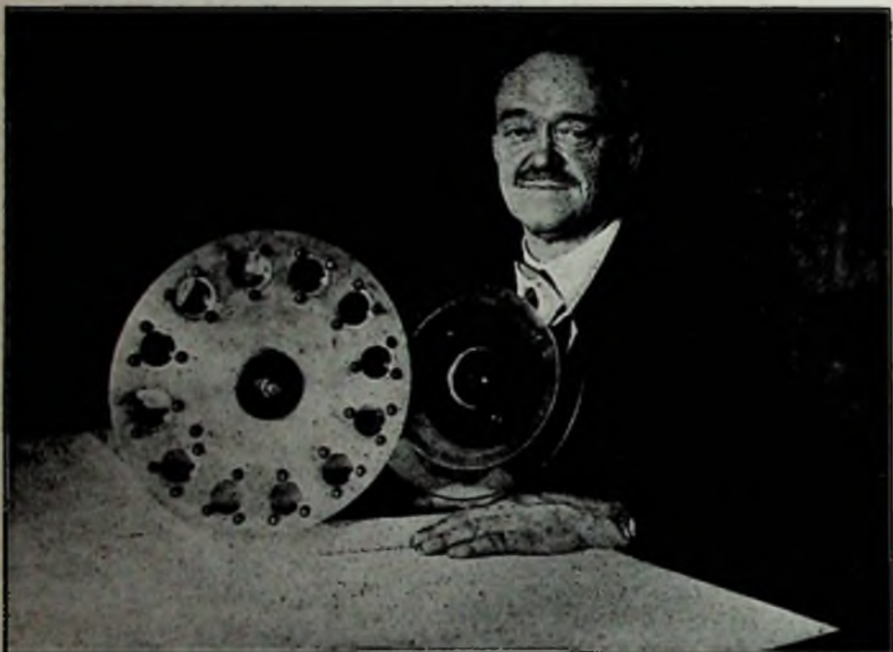
The arrangement of the receiving apparatus. The neon tube is shown withdrawn from the drum for clearness. In operation it fits inside the hollow shaft of the drum.

contact brushes have just made contact with the upper right-hand ring, as shown in Fig. 2, and that one of the quartz rods in the first, or outermost circle, is pointing straight up, this condition corresponds with the start of a picture in the transmitter, when the light spot is just commencing to sweep across the film.

Building-up the Image.

As the contact brushes have just closed the circuit to the neon tube electrode at the extreme right, this electrode lights up immediately and fluctuates in brilliancy exactly in accordance with the modulation of the signal. The fluctuations of light are carried up the quartz rod and projected through the holes in the outer drum upon the mirror. The light thus reflected from the mirror follows the shading of the images on the original film, so that a picture is built up in the mirror. This picture may then be observed through the magnifying glass.

A complete picture of forty-eight lines (corresponding to the rate of transmission) is built up on the mirror with every four revolutions of the drum. At the beginning of the second revolution, the contact brushes turn to the next segment of the switching ring (because of the gearing) and the second electrode of the neon tube becomes operative. The third and fourth quarters of the picture are similarly built up from the third and fourth electrodes, and the cycle then commences again with the first electrode.



Mr. C. Francis Jenkins with (over his left hand) the "prismatic disc" which he invented. This disc has an outer rim ground in the form of a prism of gradually and continuously varying angle. By rotating this disc in a beam of light the light beam can be bent to and fro and caused to explore a picture.

During one second the drum revolves 60 times. Since four revolutions create one picture, 60 revolutions create 15 pictures, which gives the speed of 15 pictures per second mentioned when the action of the transmitter was being discharged.

It is, of course, necessary for the transmitting and receiving mechanisms to run absolutely in synchronism, but Jenkins does not provide any special synchronising method. For the purpose of the demonstrations given in Washington, the transmitter and receivers were driven by synchronous A.C. motors, and as the motors took their power from the same power line, it is reported that little difficulty was experienced in keeping the pictures steady.

Witnesses describe the pictures, as viewed at a distance of about ten feet from the magnifying lens, as being clean-cut silhouettes against the characteristic reddish background provided by a neon tube.

Synchronising Difficulties.

This apparatus is interesting and distinctly novel, but it should be clearly understood that it does not produce television. It transmits and reproduces only moving shadowgraphs of simple figures and scenes which have previously been specially prepared and recorded on a standard cinematograph film; and as there are no refinements of shading and detail to be handled, the problem of designing suitable apparatus is vastly simpler of solution than is the problem of designing apparatus which will enable true television to be accomplished.

Also the problem of synchronism has been entirely side-stepped, for although several similar synchronous motors fed from the same power supply will maintain a fairly even average speed, there is still a difficulty known as "phase swinging" to be contended with. Phase swinging will not cause the received image to be distorted, but will cause it to move slowly up and down, or from side to side, on the receiving screen. To correct this fault manually, and to correct also minute changes in motor speed by any manual method, requires considerable skill, and even then the operation partakes of the nature of a juggling feat.

(*Continued from page 22.*)

The electrolyte used with these cells consists of a saturated solution of ammonium phosphate, to which is added a teaspoonful of gum and a teaspoonful of sodium carbonate.

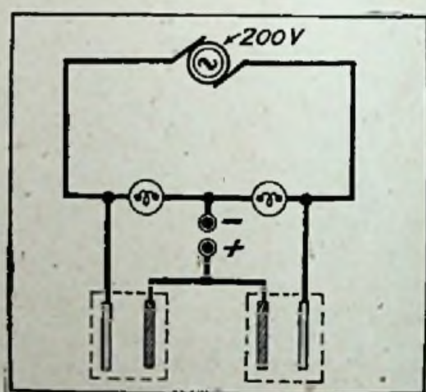


Fig. 3.
The connections of the rectifier.

After filling the jars a short length of rubber tubing should be slipped over the anodes at the point where air and water surfaces meet. The tin or lead container is then filled with water (for cooling purposes) and the lamps are placed in the sockets—e.g., 150/25 carbon fil. for an 80-volt D.C. output in cases where the supply is 200 volts D.C.

In the Realm of Jellies

By W. F. F. SHEARCROFT, B.Sc., A.I.C.

There is every possibility that colloidal selenium, or colloids made up from other light-sensitive metals, may yet play a most important part in television. For those who desire to conduct experiments in this direction, therefore, and also for those of our readers who merely wish to keep themselves well informed on all branches of the new science of television, the following article is of particular interest. Our contributor, who is a master of his subject, explains in a simple manner exactly what colloids are. He points out that the subject of colloidal chemistry is still in its infancy, and that there is still considerable scope here for the research worker.

SELENIUM, the chemical element of many surprises, occupies an important place in the art and craft of television. In common with many other elements it displays the property (which the chemist calls *allotropy*) of existing in many different forms. It exists in a *metallic form*, and also in a crystalline form, closely allied to sulphur, and thus appears to function as both a metal and a non-metal. We also hear of *colloidal* selenium, and may suppose that this is yet another form of what has been so aptly termed the Moon-Element.

Here, however, a misunderstanding has arisen, which is being too often confirmed in popular literature. As colloidal selenium is likely, in the future, to play a more prominent part in television it may be useful to know what exactly is meant by the term "colloidal."

Centuries ago it was known that certain so-called solutions were very difficult to filter; many in fact refused to filter at all. You will find, for example, that if your pot of gum is dirty you cannot clear it by the simple process of filtering it, as you could a sample of muddy water.

The first scientist to take up this matter seriously was Thomas Graham, who hailed from Scotland, and who at one time was Master of the English Mint, a very proper thing for a Scotsman to be! Graham studied these difficult-filtering solutions, particularly by the process which is known as *dialysis*.

Dialysis consists in placing a solution in such a condition that it can filter through some vegetable or other artificially-prepared membrane. For simple experiments a piece of parchment is a very suitable membrane. One can purchase a couple of rings, the one sliding into the other, and stretch the parchment between them, similarly to a tambourine. But a very efficient dialyser can be made by tying the parchment round the bottom of a tumber and then placing it in water till it is soft and can be moulded to the shape of the glass. Then, on removing and drying, we have a parchment vessel, through the top of which a string can be threaded as shown in Fig. 1.

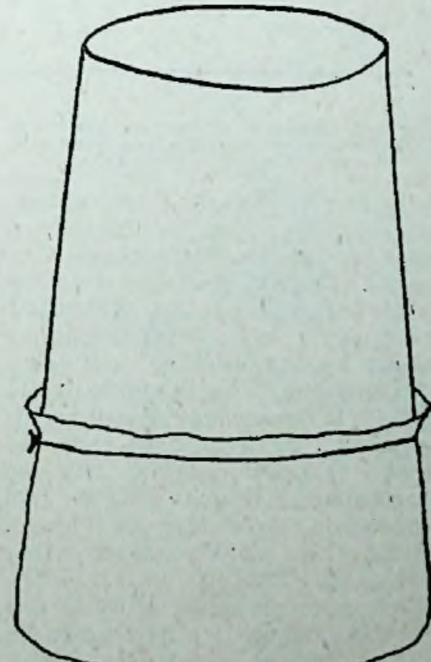


Fig. 1.
Preparation of Parchment Vessel.

To use this homely apparatus it is hung up so that it just rests within a larger vessel of water, and the solution to be dialysed is poured into the parchment vessel, and water added to the outside until the inside and outside levels are the same (Fig. 2).

If into the parchment vessel we put a solution of common table-salt, then, in a very short time, we shall be able to detect the presence of salt in the water in the outer vessel by its taste; or a more delicate test is to add a solution of silver nitrate, which with common salt gives a white precipitate. It will be necessary if this latter test is adopted to use distilled water for our experiment, as the ordinary domestic supplies will give a reaction with silver nitrate.

If now a little white of egg be dissolved in a solution of salt—it is not soluble to any extent in water—and this mixture placed in the dialyser, then the albumin does not pass through the parchment. A very simple method of recognising the albumin is to boil the liquid suspected of containing it. When boiled albumin coagulates, a process familiar to us all in the setting of the white of our morning egg.

Graham investigated such cases as these, and came to the conclusion that he could divide substances up into two classes—those which produced solutions which passed easily through a dialyser, and those which either would not pass at all or did so only with great difficulty. The former he called *colloids*, the latter *crystalloids*.

Important as Graham's work was, his conclusions have since been proved to be incorrect. No longer do we believe in the two-fold division of matter; but it is considered that, with appropriate methods, all substances can be made to assume the state of a colloidal solution. Thus, for example, common salt is a crystalline body which ordinarily dissolves in water to give a solution which passes through parchment, but by suitable treatment it is possible to obtain a mixture of salt and water which will not dialyse.

Thus we speak of the colloidal *state* and not of the colloidal *form*; and after Graham's fundamental work research was directed towards ascertaining what was the cause of the difference between an ordinary solution and a colloidal solution, usually known as a *sol*.

Value of the Microscope.

Very little progress was made until after the invention of the ultra microscope, which views tiny particles in a beam of light. By the measurements determined with this instrument it has been possible to classify as sols those mixtures of two substances in which one is distributed throughout the other in particles with diameters between the approximate limits of one ten-thousandth of a millimetre (0·1 μ) and one millionth of a millimetre (1 $\mu\mu$.

Thus we have a complete range of states from the solution proper containing molecules or ions, passing through sols, containing larger particles to mere suspensions of material which settle down quickly. It is the non-settling or extremely slow settling of the sols which distinguishes them from mere suspensions. It is the larger size of the particles which distinguishes them from the easily-filtering, true solutions.

Two Substances in a Sol.

Of the two substances in a sol the one which is continuous (the water in the cases considered above) is called the *dispersion medium*; the one distributed through it is the *disperse phase*. It is not necessary that a solid and a liquid be employed. Many other mixtures exhibit colloidal properties, and they are usually roughly classified as shown in the following table :—

DISPERSION MEDIUM.	DISPERSE PHASE.	EXAMPLES.
1. Gas	Liquid	Fog, mist.
2. Gas	Solid	Smoke, fine dust.
3. Liquid	Gas	Froth, foam.
4. Liquid	Liquid	Emulsoids.
5. Liquid	Solid	Suspensoids.
6. Solid	Gas	Pumice stone
7. Solid	Liquid	Many minerals.
8. Solid	Solid	Many coloured minerals.

Sols can be separated from true solutions by dialysis, but this is not their only important property. The addition of a small quantity of an electrolyte—a substance which produces an electrically conducting solution—produces marked changes

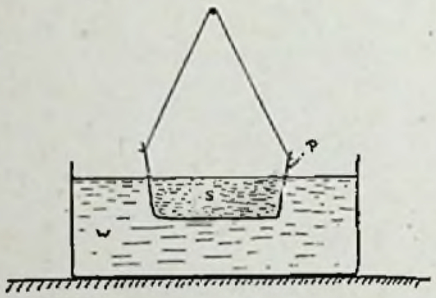


Fig. 2.
Simple Arrangement for Dialysis Experiment. P=Parchment vessel, containing solution S, suspended in dish of pure water, W.

in many sols. In some cases a change of colour occurs, accompanied by a complete precipitation of the disperse phase. Thus if two solutions are made of copper sulphate and potassium ferrocyanide, each containing about 1 gram per litre, and equal quantities of these solutions are mixed, a clear brown solution is obtained. It is best to pour the copper sulphate solution into the potassium ferrocyanide solution, and constantly stir during the process. A test with a dialyser will prove that this brown liquid is a sol. If a little dilute salt solution be added to this sol then complete precipitation of the disperse phase occurs, leaving a colourless dispersion medium above.

Precipitation, however, is not the only result of the addition of electrolyte. In some cases the whole colloidal solution sets to a jelly. In some cases the production of a jelly appears to be dependent upon temperature, certain substances forming sols above a certain temperature and "gels" below.

Electrically-charged Particles.

The particles in a suspensoid are electrically charged, and in some way, not thoroughly understood, the stability of the sol depends upon the charge; for when the charge is neutralised the disperse phase settles down, even if slowly. In the majority of suspensoid sols the charge is positive, and coagulation by means of an electrolyte appears to consist of the neutralisation of this charge by the negatively charged ions produced by the electrolyte.

Any solid in contact with a liquid becomes charged, but the effect of the charge is inappreciable unless the surface is very large. A moment's reflection will show that the surfaces concerned in a sol are enormous in comparison with the total amount of matter present. The surface of a small tea-cube of sugar is approximately 6 sq. cms.; if we cut it into two then the surface becomes 8 sq. cms. Divided into eight the surface is 12 sq. cms., and as further division takes place the surface area continues to increase. At the stage of division existing in a sol the surfaces are enormous, and thus surface phenomena become of great importance, and results occur which would appear at first sight to be almost magical.

Wide Scope for Investigation.

Colloidal chemistry has been utilised in many technical processes, mainly as a new method of attack on old problems. The whole subject is yet in its infancy, but with further attention there is little doubt that considerable extensions will be made in the utilisation of the findings of those working within this field.

Selenium in the colloidal state may play an important part in the future of television. Prepared from a very dilute solution of selenium dioxide by reduction with hydrazine it is a vivid red colour. By grinding up very fine selenium powder with a small quantity of aniline, and then pouring the mixture into a larger quantity of alcohol with vigorous stirring, a yellow colloid solution is obtained after reducing the temperature to —80° C. The selenium sol is a typical suspensoid.

For those who desire to go into this subject in more detail the following books provide a very useful introduction, and in them will be found references to more advanced literature:

"An Introduction to the Physics and Chemistry of Colloids," Emil Hatschek.

"The Formation of Colloids," Svedberg.

Stereoscopic Television and Natural Vision

By J. DARBYSHIRE MONTEATH

This month our well-known contributor has devoted his article to a discussion on the relationship between stereoscopic television and ordinary human vision, which, though few of us realise it, is stereoscopic.

STEREOSCOPIC television marks a still further advance towards the ideal of distant communication demanded by the organs of sight.

Whether the objects placed before the transmitting televisor be illuminated by artificial means, or whether they are in daylight or in darkness, the distant televisor receiver is now capable of reconstructing the scene in luminous visions that show form and relief as in natural vision.

Natural vision demands the use of both eyes, for with one eye only it is impossible to estimate accurately either size, form, or the distance away of the objects seen. So with the new stereoscopic televisor two lenses are provided, and both eyes are employed to secure an illusion satisfying to the mind that the lifelike images observed are true to their reality, in that they are correct in size and distance and solid in form and relief.

Visual Judgment.

To understand the principles underlying the rapid progress that has been made by the production of this latest of the Baird televisors, it is necessary to give some attention to the processes involved in natural vision which have suggested mechanical aids in the design of this television stereoscope.

With experience in the use of our organs of vision we have developed mental and psychical processes, quite apart from the mere use of the motor mechanisms we employ in binocular vision; for we associate conceived ideas with our optical experience, and so guide the mind to the enjoyment of visual judgments.

By experience the mind realises objects in their proper position, in spite of the reversion of the image on the retina, and information is given us by the muscular sense resulting from the use of the ocular muscles; for the estimation of distance may be judged by the effort of accommodation. The less the effort so made the greater the distance away the object will be, in comparison to other like-sized retinal images. Actually we infer which object may be most distant by the least convergence of the optical axes.

Readers of this article will learn, perhaps for the first time, that natural vision demands the use of BOTH eyes to obtain lifelike images; that it is by experience that the mind realises objects in their proper position (i.e., perspective); that the estimation of distance is the result of the use of the ocular muscles. Several simple examples are quoted to demonstrate these principles.

BREWSTER'S LENTICULAR STEREOSCOPE.

Fig. 1. This early form of refracting stereoscope is made up of two half lenses.

Eyes of Animals.

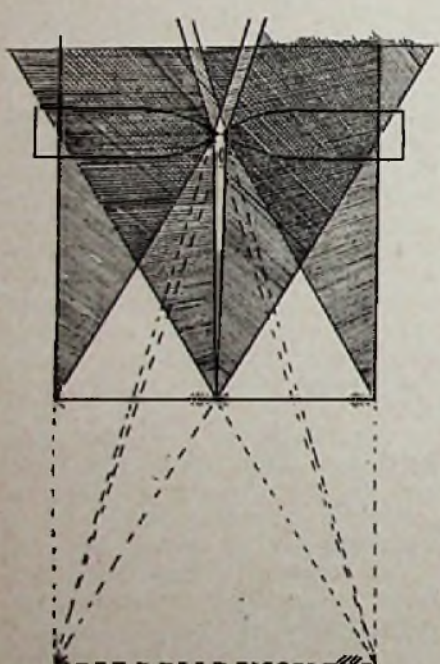
Animals with stereoscopic vision have eyes in front of the head, so that both eyes with their optical axes can be focussed on their moving prey. Some animals, however, have panoramic vision only, but these are found to be mostly vegetable feeders who have not the same need of stereoscopic vision. And so it seems that the greater the complexity of the fore limbs of animals the more developed is the fixation of the eyes that guide them, and with their experience there develops a visual area which corresponds with the same half of both retinæ, experience of which guides their sense of direction. It is interesting to note that subsequent blindness does not destroy this sense of direction; yet if the occipital lobes be deceased or removed this sense of orientation is lost, for motor and sensory impulses no longer exist as an aid to conceptions and judgments.

Vision with two eyes secures that the field of vision is larger than with one eye, and the perception of depth is easier as the image on the retina of each eye is obtained from different positions. It is by aid of these two viewpoints that solidity and distance are realised by the convergence of both eyes.

Both eyes always move simultaneously, even when one eye is blind, and the movements have a precise relation to the movements of the head.

When the eyes are at rest the muscles are in equilibrium, one muscle acts when the eye is moved inwards or outwards; these muscles act in the movement upwards or downwards; three muscles are employed in the movement towards an oblique position, and the extent of the movements diminishes with age. It is this associated movement that concerns us in the study of stereoscopic vision as applied in the stereoscopic televisor.

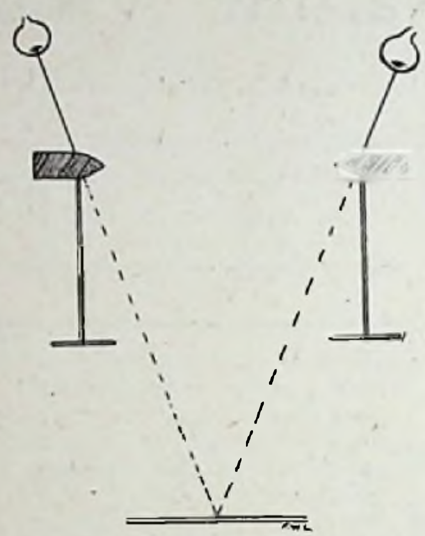
So it is the stimulation of identical points in both retinæ that by a psychical act cause us to appreciate the oneness of two visions as seen in nature by two eyes, and to secure this effect in the televisor two images are produced by the transmitting device from aspects that would be registered by the two retinæ. These two resulting images are then displaced by the lenses employed at the receiver so as to be superimposed by the observing retinæ to result in an effect of binocular vision.



STEREOSCOPIC VISION

Fig. 2.
Showing the path of rays of light reflected from an object to the eyes.

Just as both eyes do not give exactly similar images of the same object owing to the position of the eyes in the head, so the sensitive cells of the television transmitter are made to respond to light reflections due to their relative positions, these positions being adjusted so that the reflections of focussed rays from the object being televised operate upon them.



PATH OF RAYS IN STEREOSCOPE.

Fig. 3.
A simpler representation of Fig. 2.

Hence the sensitive cells can be made to "see" from different points of view, and like one eye, one cell (or battery of cells) will register the light effects of the side nearest to it, and the other cell (or battery of cells), like the other eye, will be affected by the other side point of view.

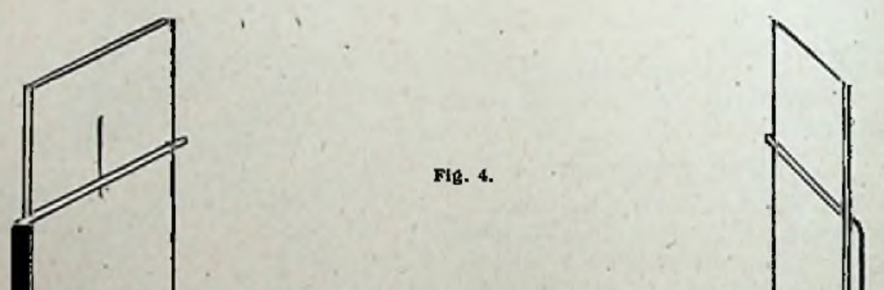
These light impulses react on the amplifying assembly and the voltage variations affect the luminous unit at the receiving instrument. The particular point in the stereoscopic instrument is that the two images resulting from the action of the two sensitive cells are superimposed by the displacement effected by the two viewing lenses.

Emergent light from an object or image is always bent away from the edge to the thicker portion of a lens, and this property was made use of by Brewster in devising the stereoscope, and in the early days of photography stereoscopic cameras, which made use of two lenses that would act like two eyes, produced photographs that could be superimposed by the two lenses of the stereoscope and give the effects of relief and distance.

Wheatstone obtained a similar effect by reflecting the images so as to make them superimpose.

Fig. 1 shows the stereoscope as completed by Brewster. This refracting instrument is made up of two half lenses, and rays from the object are shown in Fig. 2 and Fig. 3. Brewster's invention dates about 1843, and Mr. Baird's application to the televisor is August, 1928.

Fig. 4.



WHEATSTONE'S REFLECTING STEREOSCOPE

Wheatstone invented his reflecting stereoscope in 1838 and superimposed images by two mirrors reflecting at appropriate angles (see Fig. 4). In each instrument two similar drawings, pictures, or images in perspective as viewed by each eye, are superimposed to form a single picture.

The mind plays its part in combining these images, for there is a psychical tendency to fuse the double images of the retinæ with one single object, and the conscious muscular effort assists.

The above-mentioned drawings should therefore be viewed through lenses simultaneously by both eyes, thus causing the visual lines to converge towards a point, images of corresponding points in the two

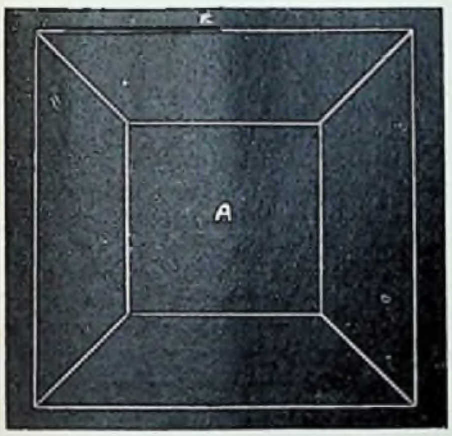


Fig. 5.
Mach's Pyramid, which shows solid or hollow, according to the viewpoint, or action of the ocular muscles.

drawings being formed on the foveas of the two eyes.

Experiments.

Hold up a pencil between the eyes and any distant object and notice that you see two pencils.

Shut first one eye and then the other eye and realise which eye sees which image of the pencil.

By a muscular effort in making the optic axes converge more the single pencil will be seen, and it is this effort that is called into play when we see solid objects or images in relief.

Take a pair of stereoscopic photographs and direct the visual axis of each eye to the picture held opposite and the single picture seen will be observed to be in relief.

Hold the hand edgewise in front of the face and, after looking at it with both eyes, close one eye and then the other and think of the associated ideas conveyed which give the idea of solidity.

It was soon noticed that the reversed position of stereoscopic photographs gave opposite effects, and instruments were designed for the study of this phenomena.

Pseudoscopy was the name given for the consideration of reversed images produced by lenticular and mirror pseudoscopes which produced reversible perspective.

And so "transposition," or the interchange of objects for the right or left eye, or "subversion," which involved the exchange of the upper and lower portions of view, or "reversion," which included the mental interchange of the foreground and background of the object viewed, were observed by appropriate instruments. But judgments of this kind may be distorted without the aid of instruments. All are dependent on our experience, and the fixation motives of our vision are the resulting conceptions that we form from looking at an object.

In Fig. 5 we show Mach's truncated pyramid which he designed to show that according to our observations the figure will appear hollow or solid. Moving the figure from right to left will give the impression of change from a concave to a convex appearance of the pyramid.

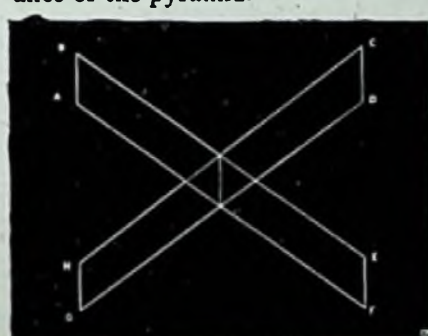


Fig. 6.
Sandford's interesting planes, illustrating how reversals can be produced according to viewpoints.

Similarly the Mach's book may appear with the line *b* and *e*, forward or backward, according to the viewpoint, as in Sandford's planes (see Fig. 6), and view while moving it up and down. But most interesting are the fluctuating blocks (Fig. 7), which show startling reversions. At one time the white blocks will appear as the upper steps and at another, according to concentration on the aspects of the picture, the lines will be the steps.

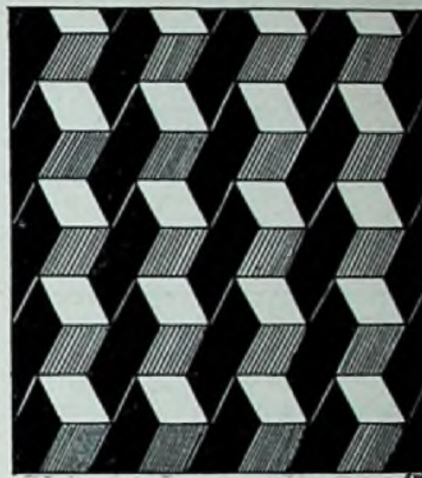


Fig. 7.
THE FLUCTUATING BLOCKS.
According to one perspective the white blocks have their white surfaces above, with the striated surface below, and the black side on the left. Close the eyes, and on opening them observe by the other perspective that the white is underneath; the black is on the right and the striated surface is now the upper one, or part areas may be reversed. The effect is best obtained by opening and closing the eyes and rotating the diagram.

Experiments in vision with these pictures make us realise the value of preconceptions in viewing the images produced by television, and for this reason human faces and familiar objects at once appear most satisfying, so that it is well that the first transmission of a television broadcast will be of popular and habitually recognised subjects.

The Council of the Television Society has learned with profound regret of the decease of the late Lord Haldane, the Society's first President, and beg to convey their deep sense of sincere condolence with his relatives.

The Three-Colour Process of Photography

By F. AVERY

The invention of colour television introduces a new factor into the newest of sciences, a factor which makes it advisable for experimenters and others interested to have some knowledge of colour work. In the following article the writer tells his readers how three-colour photography and three-colour printing are carried out.

OUR contributor, who has had many years' experience of colour photography and colour printing, points out the similarity which exists between methods used in these processes and the method used by Mr. Baird to obtain television images in their natural colours.

After reading in the August issue of TELEVISION a very interesting article on the recent demonstration given by Mr. Baird of the transmission of television images in natural colours, and noting that the principles are similar to the three-colour process of photography as applied to colour printing, I think it an opportune moment to give in a simple manner a general outline of the methods used in the production of ordinary three-colour plates.

Three Primary Colours.

As is generally known, if the visible part of the spectrum be divided into three sections we get the three primary colours—orange, green, and violet.

Each one of these colours is the complementary colour to the other two, the three colours together containing all the rays necessary to make white light or light of any other colour.

This can be demonstrated by means of three projecting lanterns, using in conjunction with each a colour filter of one of the above colours and throwing the beam upon a white sheet, when the rays coming through the green filter will show green. If orange rays are then thrown on the green the resultant colour on the screen will be yellow, and violet rays superimposed upon the yellow will show white again. Or again, violet rays thrown upon the green will show blue, and violet on orange will show red; but a *combination* of all three, however imposed, makes white (see Fig. 1).

It will thus be seen that in the case of light the three primary colours are orange, green, and violet; and the three secondary colours are yellow, red, and blue. In the case of printing, however, the order is reversed, yellow, red, and blue being the primary colours, and by superimposing the three in full strength we get black, or by blending, any desired colour (see Fig. 2). So that in the reproduction of, say, a painting, the colours have to be dissected by photography, using panchromatic plates, and colour filters complementary to the primary colours to be recorded.

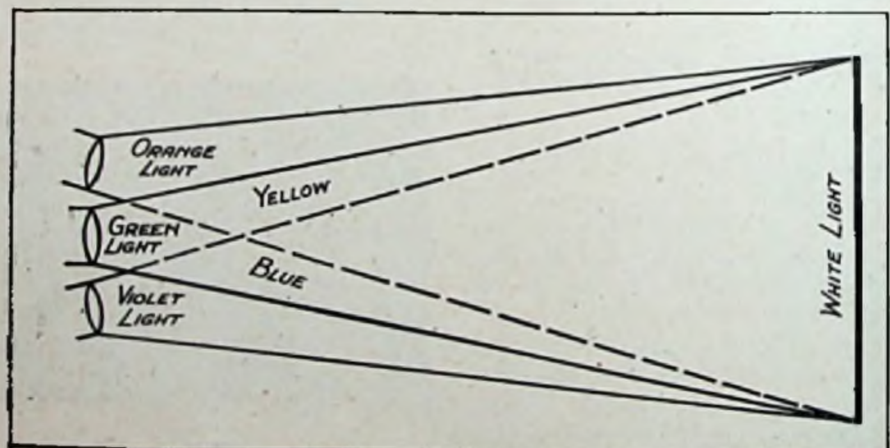


Fig. 1.
Diagram showing the effect which is obtained when the three primary colours (as applied to light) are superimposed upon one another.

The colour filters generally used are made of celluloid stained with aniline, and these are placed either in or behind the lens, while the negative is being made.

A practical example of what the colour filter accomplishes in the making of the negative can be demonstrated by viewing a coloured object through, say, a piece of red glass, when the blue parts will appear very pronounced, whilst the reds, and colours not containing blue, will appear light.

Obtaining the Printing Surface.

The sensitised plate is placed in the camera behind a half-tone screen which records a series of dots on the negative which, when printed and etched on the copper plate, give the necessary printing surface. This must be done so that the tone values of the original colour can be converted into relief printing surfaces, that is, dots of different shapes and sizes.

It is necesssary in making three-colour negatives that the grain of the half-tone screen shall run at a different angle on each of the three negatives, so that each colour is placed 30° from the other two, because if the same screen angle were used for each colour the dots would in places fall directly over one another and in

(*Continued on page 41.*)

Bridging Space
(*Part III*)
By JOHN WISEMAN

This is the third of a series of articles in which the fundamental principles of electricity and wireless will be explained in the simplest possible language.

WE terminated our article last month at a very interesting juncture, for having traced how an electron movement can cause wireless waves, and having seen also that a circuit consisting of a simple coil and condenser has the property of producing an oscillation, we must now find some means of enabling the oscillating energy in our closed circuit to be propagated into space.

Referring to the closed oscillatory circuit (Fig. 4 on page 26 of our last issue), we know that once the condenser is charged it will discharge through the inductance and initiate a current or, to be more exact, a flow of electrons, which moves to and fro round the circuit to give us what is termed an oscillatory current. Between the condenser plates there will exist an electrostatic field, owing to the strain produced in the dielectric consequent upon the rapid changes of electron distribution on the plate surfaces. As a result of the mechanical construction of this condenser, it is quite easy to see that the lines of electric force in this field will be almost wholly concentrated between the plates, it being assumed in the circuit shown that the plates are close together with a separating medium of an insulating material.

Limiting Factors.

From previous articles the reader will also realise that the electron flow in the inductance coil produces a magnetic field consisting of lines of force which are more or less confined within the limits imposed by the coil's dimensions, the existence of divers coil formations being brought home by a glance at the accompanying photograph, which shows a few representative coils used for wireless receivers. These two factors automatically set a limit on the distance over which the oscillations in our circuit can be detected, so it becomes necessary to adopt some means for extending the influence of these lines of force. Our thoughts this month, therefore, become centred on an arrangement for spreading out the lines of force, and once this is done we shall be able to understand better the transmission of wireless waves.

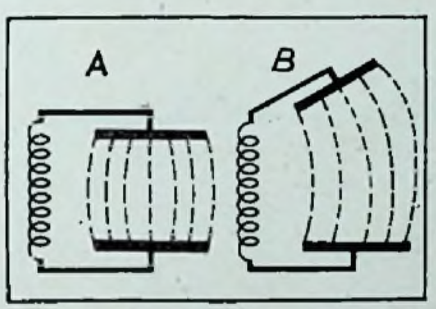


Fig. 1.
The effect of widening the distance between condenser plates.

Logical reasoning should soon reveal to the reader that from the practical standpoint an alteration in the physical dimensions or shape of the condenser lends itself very well to our scheme and is to be preferred to any attempt at altering coil size or formation.

Looking at Fig. 1 A, suppose we remove the dielectric of insulating material and let air form the separating medium between the plates, and also move the plates a greater distance apart than they were initially. The lines of electric force between the condenser plate surfaces immediately spread out, tending to bulge at the centre, and no longer follow the short straight paths which existed in the compact design. We can increase the separation, as in Fig. 1 B, and cause a further spread, until finally we have the system shown in Fig. 2.

Evolving the Aerial.

The lines of force now spread out to a considerable extent and our system of coil and condenser can be modified to consist essentially of a coil with one extremity joined to a vertical wire and the other end attached to a large plate. This second plate of our condenser, however, may be done away with altogether, if we take advantage of the fact that the earth is a conductor. It simplifies matters considerably if we just join the bottom end of our coil to the earth, and the lines of electric force then pass from all points along the vertical wire to the earth, spreading out and producing a sort of umbrella effect round this system.

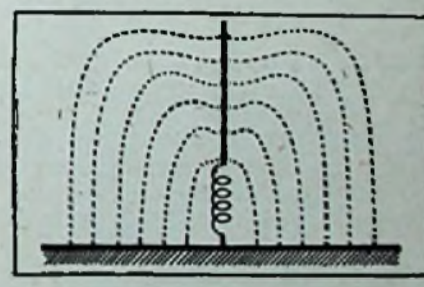


Fig. 2.
A simple form of aerial, based in principle on Fig. 1.

The arrangement that we have just evolved still retains the oscillatory circuit properties of the coil and condenser shown in our Fig. 1. No electrical alteration has really taken place; the alteration is merely dimensional, and the result is the simplest form of aerial.

Undoubtedly the aerial which we have represented diagrammatically in Fig. 2 differs considerably from the so-called aerials which decorate the back gardens of many houses and which are used for the purpose of absorbing some of the energy broadcast from the different wireless stations; but, forgetting for the moment their failure to approach a high degree of efficiency, either electrically or mechanically, they all possess those two important characteristics of capacity and inductance.

The Combined Effect.

In an article of this nature it is beside the point to use the space at my disposal for a dissertation on the various types of aerials, together with the advantages and disadvantages of form, or even points to study when erecting one for personal use. Our aim is to expound fundamental principles in the simplest manner, so let us see how our simple aerial will function.

Deferring for the moment any consideration as to the means adopted for energising the aerial, we can assume that there is a rapid to-and-fro movement of electrons up and down the aerial wire. Each electron in changing its motion generates a minute electro-magnetic wave, so that provided the power produced in our aerial is sufficiently large, the resulting *combined* electron movements brought about by each individual effort of an electron will be instrumental in generating a large electro-magnetic wave.

"Ripples" in Space.

The lines of electric force radiate from the aerial in much the same way as is shown in Fig. 3, and it will be observed that the "ripple" in space manifests itself near the earth in the form of a series of vertical electric fields alternately upwards and downwards. Furthermore there are lines of magnetic force round our vertical aerial wire, and these are shown in Fig. 4, spreading out like the expanding ripples in a pond when a stone is thrown in.

It must be borne in mind, however, that this magnetic field does not exist separate from the electric field; it is merely illustrated in a separate diagram for the sake of clearness. The *double* system of electric and magnetic lines constitutes our electromagnetic wave and moves outwards in all directions from the transmitting aerial, so that any point distant from the aerial we can detect or measure with suitable apparatus a vertical electric field and a horizontal magnetic field.

The type of wave transmitted, that is, whether lightly or heavily damped, continuous or modulated, will depend upon the apparatus used for transmitting and will be dealt with later; but we are now in a position to conceive what is actually happening when an aerial sends out electromagnetic or wireless waves. A reference to Fig. 3 will indicate what is meant when we refer to a wavelength, i.e., the distance between two similar points on a complete cycle.

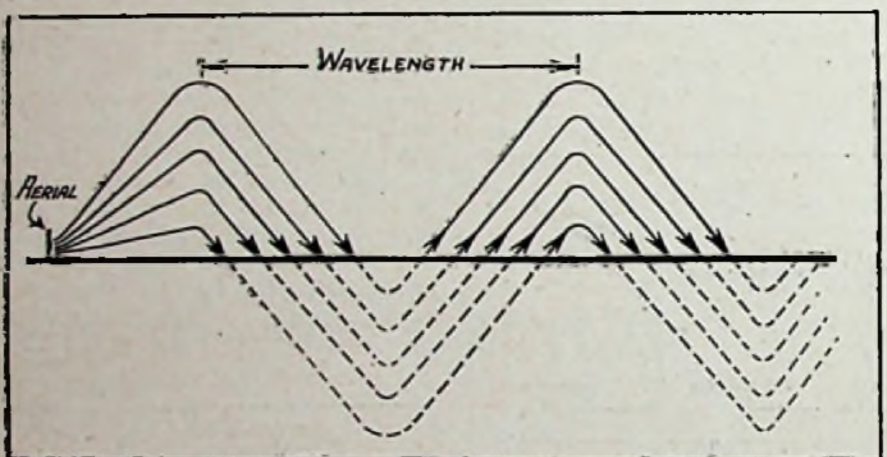


Fig. 3.—Diagram showing what happens when a wireless signal is transmitted.

Flexibility.

It will be obvious at this stage that our aerial transmitting system, apart from its ability to propagate into space energy which is fed into it, must also lend itself to adjustments as far as variations in wavelength are concerned, otherwise we should be unable to pick out the various transmissions. For example, you have seen it mentioned several times in the columns of this journal that experimental television broadcasts could be "heard" on a wavelength of 40 metres, whereas most of our ordinary broadcast reception is on wavebands extending between 250 to 550 metres and 1,000 to 2,000 metres.

How, then, can we adjust our transmitting system so that the lengths of the waves sent into space are a certain value; and is there any means whereby this value can be altered on site should such a course prove desirable?

An Important Relationship.

This brings us to the principles of tuning; but, first of all, it is necessary to appreciate that there is a certain definite relationship existing between the frequency of the oscillations in the aerial (and therefore the wave or ripple frequency) and the corresponding wavelength. Without attempting to call in the aid of mathematics, it should be easy for readers to see that if there are f oscillations in a second, at the end of one second the distance travelled out into space by a wave will be λf, where λ is the usual symbol employed to represent the wavelength in metres.

But the distance travelled in one second is obviously the velocity, hence

$$\lambda f = \text{velocity of wave.}$$

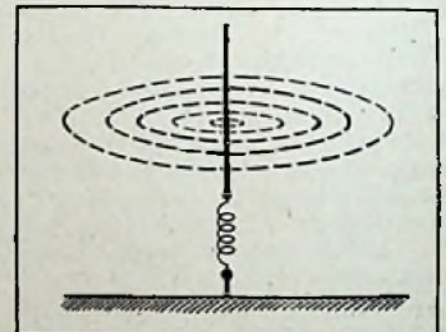


Fig. 4.
Lines of magnetic force surrounding an aerial wire.

As a result of many measurements, it has been established that the velocity of electro-magnetic waves is the same as that of light, namely, 300,000,000 metres per second, and in consequence we have the very simple but very important equation

$$\lambda f = 300{,}000{,}000,$$

where f=wave frequency in cycles per second, and λ=wavelength in metres.

The expression we have just

established enables us to calculate the wavelength of a particular transmission when the frequency of the aerial oscillation is known.

Oscillation Control.

Perhaps the easiest way to approach the question of oscillation control is to give an elementary analogy. If we take a pendulum, or, for that matter, any heavy body suspended from a string, we know that it possesses a certain natural period of oscillation. That is to say, if it is set swinging, the swings, although decreasing in amplitude, owing to the presence of friction at the point of support, etc., are quite regular; and we can say that there are so many swings per second. To alter the number of swings it is necessary to lengthen the string in order to reduce the number of swings per second, and shorten the string to increase the number of swings per second, other things remaining constant. See Fig. 5.

The to-and-fro electrical oscillation in the closed oscillatory circuit (or the "open" aerial circuit for that matter), can be likened to this mechanical swing of the pendulum, and to alter the natural period of oscillation it becomes necessary to alter the electrical constants of the circuit. Actually, the frequency of the electrical vibrations depends upon the values of the two quantities inductance and capacity (for simplicity the resistance is neglected), and anyone who has had any association with wireless will realise that it is generally easier to adjust the capacity of a condenser than it is to alter the inductance of a coil. Since the frequency depends upon these two quantities, by altering the condenser capacity we alter the frequency of the oscillation, a reduction in capacity causing an increase in the frequency, while an increase in

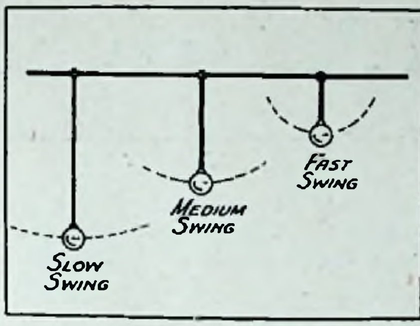
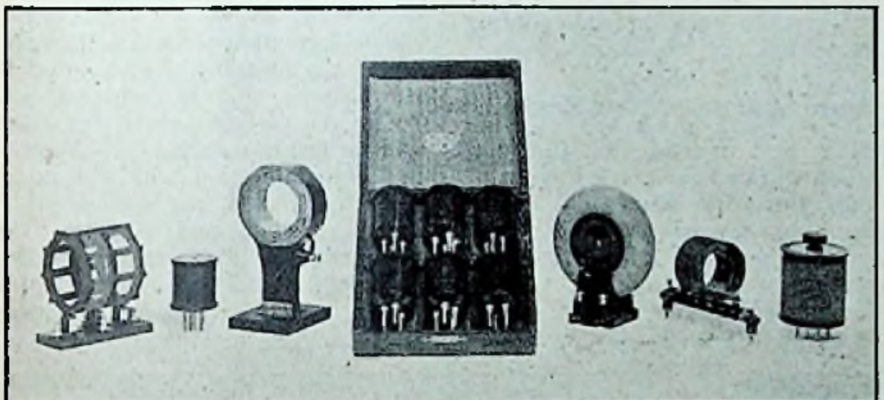


Fig. 5.
A simple analogy demonstrating differences in oscillation frequencies.

capacity causes a decrease in frequency.

Although not illustrated in our diagram, in actual practice a condenser is included in the aerial circuit, additional to the normal aerial capacity which is dependent upon physical dimensions.



A group of inductance coils as used in modern broadcast receivers.

Determination of Wavelength.

Once the exact values of the capacity and inductance are known, therefore, it is a straightforward matter to calculate the frequency of the to-and-fro electron movement, and with the aid of our previous equation, the corresponding wavelength may be determined. We shall have to touch on these principles again when we come to study the receiving side of our examination on the subject of "bridging space," but the reader should now be in a position to draw a mental picture of what is happening at the transmitting station, and be able to visualise how energy is propagated and transferred from point to point without any *tangible* connecting link.

The Television Society

A MOST eventful day was September 7th, 1927, when at the conclusion of Mr. J. L. Baird's lecture on television, on the occasion of the conversazione of the British Association at Leeds University, a vote of thanks to the lecturer was proposed by Mr. W. G. Mitchell, B.Sc., F.R.Met.S., as a member of the British Association, in the course of which he suggested, "in view of the wide public interest in television," that a society be formed forthwith to further the development of problems associated with television, noctovision, phonovision, and allied subjects. The proposal was seconded by Lt.-Col. J. Robert Yelf, another member of the British Association.

At a subsequent meeting which had been specially convened for the purpose 45 signatories, mostly members of the British Association, formed themselves founder members of the Television Society.

The First Formal Meeting.

Since the above date the Society has made steady progress, and on April 3rd, 1928, the first formal meeting was held at the Engineers' Club, Coventry Street, W. 1, when Clarence Tierney, Esq., D.Sc., F.R.M.S. (Chairman of the Executive Committee), presided and in his opening speech referred to the purpose for which the Society was formed. He was followed by Mr. T. W. Bartlett, who explained to those present the Articles of Memorandum and Association. Mr. W. G. Mitchell, B.Sc., F.R.Met.S., explained in some detail the aims of the Society.

On May 1st the first general meeting of the Society was held at the Engineers' Club, and on this occasion Mr. J. L. Baird, the inventor of the televisor, delivered a lecture on the subject of his invention, illustrated with lantern slides, and also demonstrated the reception of television by wireless. Members attended in full strength and taxed the seating capacity of the lecture room to its limit.

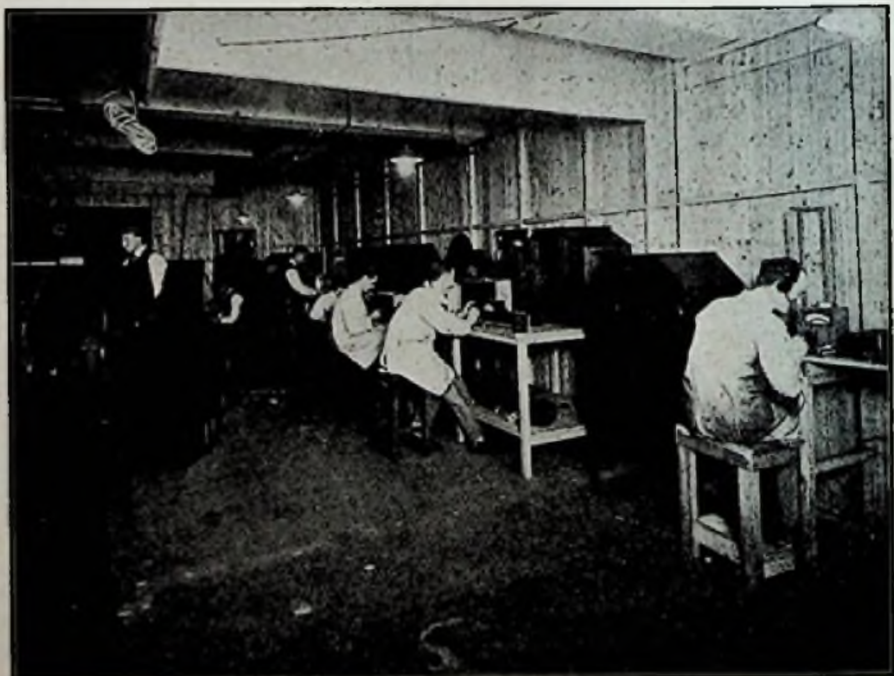
This was followed, on June 5th, 1928, by a meeting of the London section, when one of the founder members and a member of the Council, W. G. Mitchell, Esq., B.Sc., F.R.Met.S., delivered a lecture on "Light-Sensitive Cells." Owing to the approach of the summer months the Council decided to hold no meetings during July, August, and September as the majority of people usually take their holidays during that period.

Opening Date of New Session.

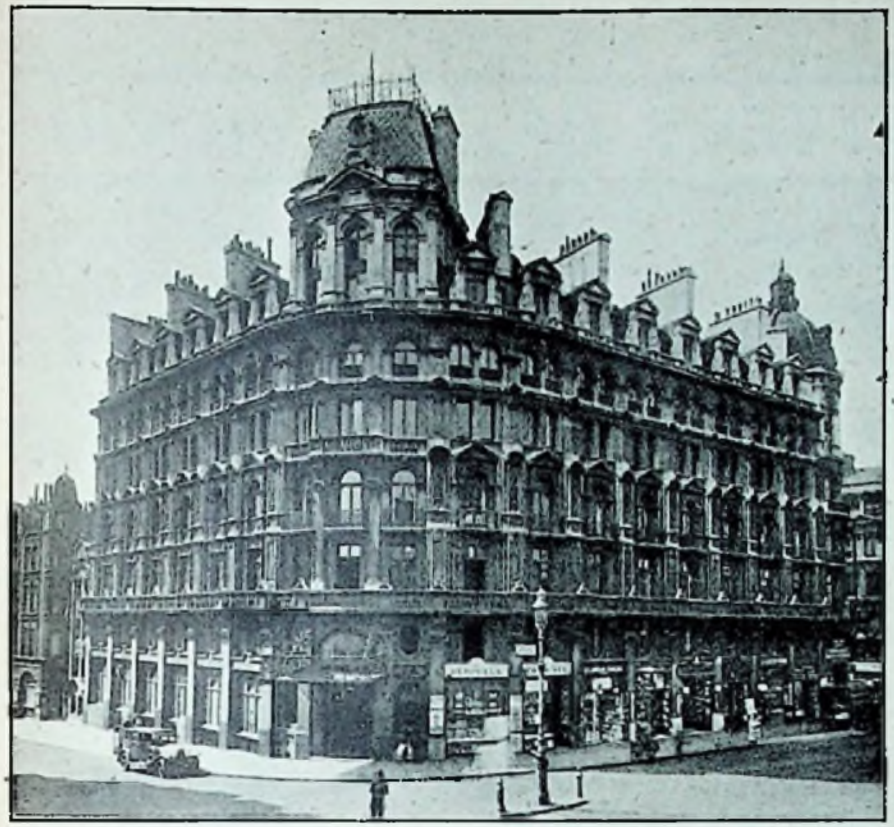
The first meeting of the new session will be held at the Engineers' Club, Coventry Street, W. 1, at 8 p.m. on Tuesday, October 2nd, 1928. The name of the lecturer, together with his subject, will be announced in the next issue of TELEVISION.

Since the formation of the Society there has been an enormous amount of correspondence regarding conditions of membership and the formation of local sections, not only from persons situated in the British Isles and the Colonies, but from such countries as Belgium, France, Germany, Holland, Portugal, Russia, and even the little island of Madeira requires not only information regarding membership and local sections, but also apparatus for the erection of a receiving station.

The formation of local and foreign sections is engaging the attention of the Council, and it is hoped that before the present year is out these will be firmly established. Another important question which is under consideration is the design of a suitable badge and certificate of membership, and as soon as a decision is arrived at and a design adopted members will have these forwarded to them.



Commercial Televisors in the making, models of which will be exhibited at the Radio Exhibition at Olympia.



The Engineers' Club, Coventry Street, W., the Headquarters of the London Section of the Television Society.

It is hoped that during the coming winter session, in addition to the usual monthly meetings, it will be possible to have members' nights, and on these occasions members will be able to meet and discuss with one another their various problems, or exhibit and explain any piece of apparatus which they have made.

The broadcasting of vision, which is promised this month, should act as a stimulus to the organisers of local sections to get together their members and discuss the receiving sets, and reports from various sections giving details of reception would be very useful indeed to headquarters.

Suggestions from members on the subjects for lectures, local sections, or members' nights are always welcomed by the Council and the secretaries. Already some useful and interesting suggestions have been received from W. H. Mayston, Esq., M.I.E.E., of Malta, and he is willing to do all he can for the Society in that island, whilst at home letters have been received from Mr. M. M. Das, B.Sc., of Wigan, Mr. A. J. Avery, of Bedford, Mr. B. B. Broody, of Newcastle, Mr. W. Coates, of Hull, and Mr. Duncan Munro Davies, of Maidenhead. It is impossible, owing to considerations of space, to mention anything like the total number of names of all those from whom useful suggestions have been received, the above being a few taken at random. The secretaries will be only too pleased to give members the names and addresses to those who would like to communicate with other members in the Colonies, foreign groups, local or London sections.

A committee is being appointed for the London section of the Television Society, and many sections are in process of formation in the provinces and abroad.

It is hoped that members and those who intend to become members will take the opportunity of visiting the stall of the official organ of the Society, TELEVISION, at the Radio Exhibition, which is to be held at Olympia from September 22nd to 29th, 1928, when it is hoped that the Assistant Honorary Secretary will be able to be in attendance each evening to meet members and friends and to give information regarding the Society. TELEVISION will be found on Stand No. 11, Avenue A, at Olympia.

F. W. LING,
Asst. Hon. Sec.

(*Concluded from page 14.*)

TABLE II.

Frequency.	Experimental Velocity in Volts.	Calculated Velocities.	
		$V = k\nu - V_0$	$\sqrt{V} = k'\nu - c$
1623	2·480	(2·480)	(2·480)
2329	1·427	1·424	1·339
1182	0·897	(0·897)	(0·897)
1010	0·148	0·286	0·495
960	Small	0·101	0·398
898	Nil	(—0·12)	0·293

NOTE.—$V_0 = 3·347$ volts.
$k = 3·590 \times 10^{-15}$ . . .

Since this energy law connects the positive potential V volts with the frequency ν by the equation $V = k\nu - V_0$, the emission of photo-electric electrons should cease below a definite frequency, the value of which can be calculated from $V_0 = k\nu_0$.

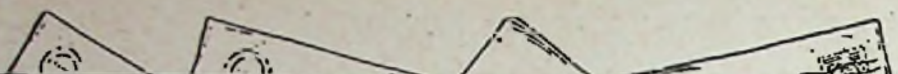
This is very important, for it means that if the light which reaches the photo-electric cell from the scene to be televised has a frequency beyond this definite frequency at which emission ceases, there will be no response from the cell, and no matter how perfect the remaining apparatus may be, television would be impossible. Readers should therefore try experiments with light reflected from objects of the same size and shape, but of various colours, thus duplicating conditions such as obtain in an everyday scene, either outside or on the stage.

Application to Colour Television.

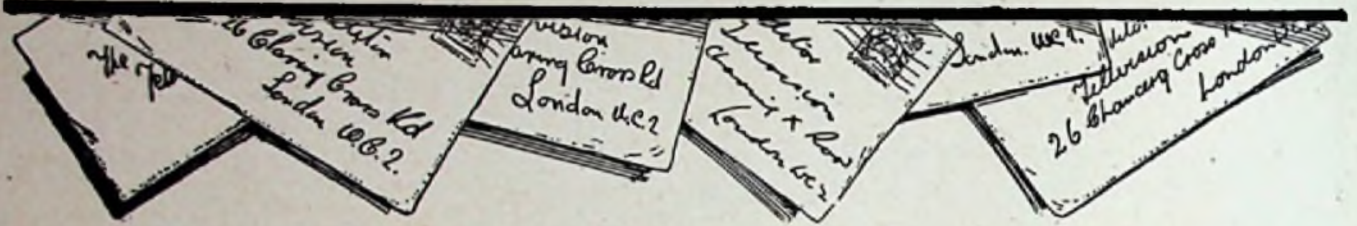
After the results of the cell response have been noted for the illumination of coloured objects by white light, the reader should repeat the experiments, using colour screens between the projector lamp and the object.

In this way we may hope to achieve not only better results than hitherto, but I am convinced that by a correct choice of the photo-electric device it will be possible to obtain an equal response over the entire visible spectrum, and thus facilitate the further development of colour television.

At the moment I am working on the idea, and believe that it is only a matter of time before someone will discover the perfect "panchromatic" photo-electric device which will give the required response.



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.*

PERIN HOUSE,
ALRESFORD, HANTS.
July 28th, 1928.

THE EDITOR,
"TELEVISION."

DEAR SIR,

May I be permitted to join in the discussion aroused by Mr. E. P. Adcock's letter in your June issue?

The arrangements suggested by Mr. Adcock and Mr. Roscoe are extremely interesting, but I am afraid they do not bring us a single step nearer to the solution of the great problem.

Undoubtedly we might cause an optical image to produce some sort of effect, directly or indirectly, in Mr. Adcock's copper plate or in the electron stream of Mr. Roscoe's two-electrode tube. Such effects would not be difficult to obtain. We could light a candle, cast its image on the disc of a radio-micrometer a mile away, utilise the energy to produce variations of potential in a transmitting apparatus, and thus announce to half the earth that the candle was lighted.

We could arrange that the energy should produce a light at the receiving end, or a sound, or light another candle. We could even make it crack nuts; but we should be no nearer to solving the problem of television—namely, that of producing an exact image of the candle at the receiving end.

Believe me, I am not trying to be facetious. How to arrange that each separate portion of a picture shall produce its own separate effect at the transmitting end, and how to arrange that these separate effects shall be "sorted out" at the receiving end—these are the fundamental problems of television.

Mr. Baird has gone a long way towards solving these very difficult problems and is going further. Therefore I would suggest that most progress may be made by proceeding along Mr. Baird's path, studying the methods he has used and the apparatus he has employed, while keeping in touch with all that has been discovered and is being discovered in the world of optics and electricity.

Yours faithfully,

W. H. JULIAN,
B.Sc. (Manchester),
B.Sc. (Hons.) London,
Fellow of the Television Society.

7, RIVERSIDE,
SUNBURY-ON-THAMES,
MIDDLESEX.
July 25th, 1928.

THE EDITOR,
"TELEVISION."

DEAR SIR,

Re the suggestion in Prof. Fleming's interesting article in the July TELEVISION (p. 7) that a two-foot lens of short focus should be used to form a real image, small and bright, to be scanned, it may be remarked that large astronomical photographic objectives of short focus have been used in astronomy for 35 years to photograph nebulæ. (I have not statistics to hand as to precise dimensions.) There are a few visual objectives in Europe of aperture 26″–30″ and in America a 36″ and a 40″.

The cost of those great lenses is, of course, very heavy. It is very difficult to find a block of flawless optical glass large enough.

As Dr. Fleming is no doubt aware, the lens system would have to be achromatised to suit the light-sensitive element or photo-electric cell employed. As research on these elements or cells is in active progress a lens now suitable might have to be scrapped any day owing to a new discovery. In the circumstances the expense seems hardly justified, especially in view of the risks to which the great lens would be exposed in conveyance to race-tracks, etc. (It might take two years to make.)

The cost is great enough if the lens is only to be used for distant objects—i.e., for rays nearly parallel to the axis, but it would be much greater if the lens is to be used for near objects. A doublet suffices for distant scenes, but a lens system of from three to six or more components is required to give a clear image of near objects. This is because the focus varies with (among many other things) the inclination of the rays to the axis, and where rays of many inclinations are involved their different foci can only be united by employing additional components.

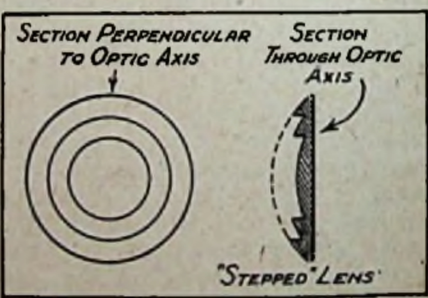
Another difficulty in connection with Dr. Fleming's suggestion is that with the fixed lens the image is fixed, and therefore the light-sensitive cell must be at least the same size as the image, even if the cell is set directly behind the perforated disc at the focus. But actually it would have to be set a little way back, to leave room for further sub-splitting mechanism, because with the single disc the grain would be far too coarse. Owing to the short focal length the rays would diverge very rapidly after passing through the focus, and hence a very large light-sensitive cell would be necessary.

With the Baird spiral series of n lenses set on a rotating disc the image suffers n displacements, and the cell need only be $1/n$th the breadth of the image.

Possibly a combination of the two plans would be feasible, the real image formed by the great lens taking the place of the "sitter" in front of the Baird apparatus.

The matter is only one small detail in a most interesting article. The arrangement suggested by Prof. Fleming in col. 7 is, of course, not new, but that is no reason why it should not be made. Indeed, most of the early televisionaries started with using a lens to form an image for scansion, on the analogy of the photographic camera, and naturally used the biggest they could get. Before May's discovery of the selenium cell, indeed, Carey actually attempted to make the photographic film perform the same function as the cell by utilising the varying thickness of deposit.

Moreover, it is curious to note that one early experimenter (Nipkow) actually adopted for his transmitter the precise arrangement described by Dr. Fleming in col. 7 (bar the dimensions), i.e., a lens forming a real image, and a revolving slotted spiral disc in the focal plane, with the cell just behind the disc. (In this case the cell was selenium, of area equal to the whole image.)



It has occurred to me that, at least for first crude experiments, possibly use might be made of the " stepped " lenses used by Messrs. Chance in construction of revolving lights for lighthouses (leading or range lights). They have very short focus. Instead of being in one solid piece they consist of a central bull's eye surrounded by successive zones, each zone being, as it were, the marginal portion of a larger lens. The different segments are cemented together. They are convex or hard crown glass, and, of course, not achromatic. Possibly a flint concave component, also stepped, could be combined with the crown, to form an achromatic doublet. It is not possible for me to judge of the feasibility of the idea, so I have written to Messrs. Chance to enquire, and asked Mr. Wharton, the director, to communicate with you if he thinks there is anything in it.

Yours faithfully,
(Miss) A. EVERETT.

" KILLOWEN,"
HOLDEN ROAD,
LONDON, N. 12.
August 4th, 1928.

THE EDITOR,
" TELEVISION."

DEAR SIR,

An interested reader of TELEVISION since the publication of the first number, I have been especially interested and annoyed to witness the hostility and incredulity which greeted the new science. Indeed, the attitude of many people is a reminder of what Galileo must have gone through.

The most extraordinary thing is that even radio " fans " are often unbelievers in television when they have proof in accomplishment before them. That Captain Eckersley should class himself with these people is truly amazing.

The ridiculous talk about " scientific theory " is, as you say, refuted by practical accomplishment, and that a more sensible attitude should not have resulted when there are so many examples of former success in " unbelieved " sciences is almost ridiculous.

As soon as I can do so I shall purchase or build—I am a radio " hobbyist "—a Baird televisor, and convince as many friends and acquaintances of the truth of your claim.

Yours faithfully,
EDWARD S. HYAMS.

DALMAKERRAN,
TYNRON,
DUMFRIESSHIRE.
August 4th, 1928.

THE EDITOR,
" TELEVISION."

DEAR SIR,

Allow me in writing to congratulate you on your very excellent paper. I have been a regular reader since it first came out, and the only complaint I have about it is that a month's an awful long time to wait for the next one, although I dare say it gives one time to assimilate the contents of the previous issue.

As a means of exchanging ideas and experiences amongst those interested in television it is, I think, excellent, and it is with this in mind that I now write.

It has always struck me as curious how light waves and electric waves both exhibit the same features and the only difference is one of frequency. In fact I am assuming that they are one and the same thing and that electric waves at appropriate frequencies will give you all the range of visible light on the spectrum and conversely that light waves give electric impulses at corresponding frequencies.

If this assumption is correct then I think it opens up a very interesting field for experiment.

I would be interested to hear any of your readers' views on the subject. If my assumption is absolutely wrong then I would like to know the proofs against it.

Wishing your paper every success.

Yours faithfully,
J. MURRAY FISHER.

(*Concluded from page* 34.)

other places fall between one another, so that the final reproduction would show a pattern of dark and light squares with no proper gradation and colour.

Method of Operating.

Firstly, one negative is exposed through the red filter, which allows all the red and some yellow rays to pass and holds up the blue rays, so that when the negative is developed the parts of the picture which are blue or contain blue are wholly or partly transparent, and where the red rays have acted on the sensitive surface of the negative these appear opaque. Thus, when this negative is made positive on to copper, only the blue parts of the original print through and appear for etching, thereby giving the blue printer.

The second negative is exposed through the green filter, which allows the blue and some yellow rays to pass and holds up the red, so that when the negative is developed the parts of the picture which are red, or contain red, appear wholly or partly transparent, and where the blue and yellow rays have acted on the sensitive surface of the negative these appear wholly or partly opaque, according to their values in the original picture. Therefore, when the negative is made positive on to copper, only the red parts of the original appear for etching, thus giving the red printer.

The third negative is exposed through the blue filter, which allows the blue rays to pass and holds up the yellow rays, so that when the negative is developed the parts of the

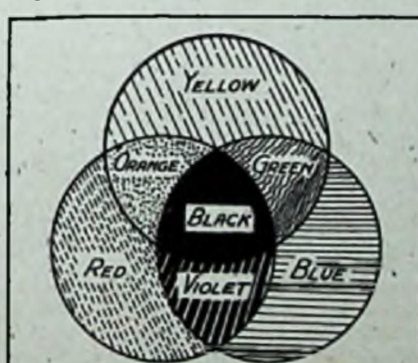


Fig. 2.
Showing the effects which are obtained when the three primary colours (as applied to printing) are superimposed upon one another.

picture which are yellow or contain yellow are wholly or partly transparent according to their relative tone values, and where the blue rays have acted on the sensitive surface of the negative these appear opaque, which means that when the negative is made positive on to copper only the yellow, or colours containing yellow, of the original appear for etching, thereby giving the yellow printer.

Now when these three etched copper plates are printed in their respective colours, in the order of yellow, red, and blue, each being superimposed in proper register, they will produced in the resulting picture the colour values of the original painting, the black parts of the picture being obtained by the solid yellow, red, and blue being superimposed.

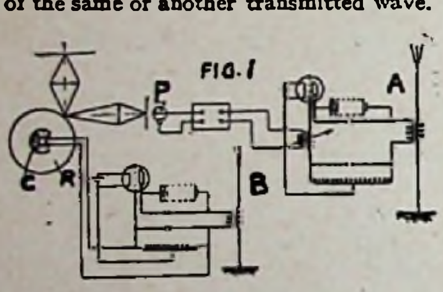
Similarity of System.

To make certain of perfect register it is necessary to use an apochromatic lens or a lens which has been corrected with equal precision for all the primary colours of the spectrum, in making the negatives. It is only in this way that negatives identical in size and sharpness can be obtained. If an ordinary lens were used the colours in the original painting would be brought to focus on slightly different planes, with the result that the negatives would differ very slightly in size, but sufficiently to throw the final reproduction out of register.

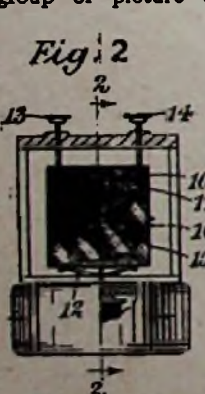
Thus it will be seen that there is a considerable similarity between the three-colour process, as applied to colour printing, and Mr. Baird's process of superimposing the three primary light colours to obtain a television image in its natural colours.

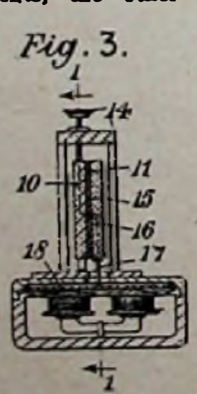
Invention and Development

PATENT No. 289,416.—Convention date, April 26th, 1927.—C. Chilowsky and A. Guerbilsky claim protection for a system of transmitting images by varying the amplitude of the transmitted wave in accordance with the light intensity of successive elements of the image, and the position of the individual picture elements is determined by the frequency of the same or another transmitted wave.



One method of accomplishing this is shown in Fig. 1, where an exploring device consisting of a rotating wheel (R) carrying mirrors projects the image on to a photo-electric cell (P), thus controlling the amplitude of the oscillations radiated by the aerial (A). A condenser (C) on the wheel (R) continuously varies the frequency of the oscillations radiated by the aerial (B). So that for each complete revolution of the exploring mechanism, the frequency generated is varied through a corresponding cycle, or alternatively it is claimed that two frequencies may be used, one varying slowly to determine a group of picture elements, the other

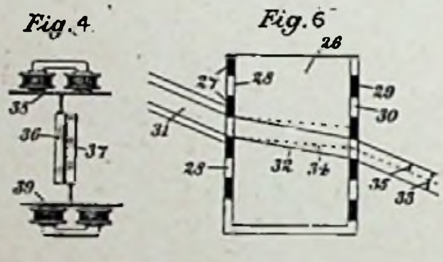




varying quickly to determine a particular element in that group.

At the receiving end, the current of varying frequency may render operative in succession a series of piezo-electric crystals, the number of crystals being equal to the number of elements comprising the image. A piezo-electric device may be controlled by one frequency, and a rotating mirror or other mechanical device may be controlled by the other frequency, the mirror being motor-driven and the motor kept in synchronism by piezo-electric means.

Patent No. 291,634.—Patent granted to J. L. Baird.—This invention provides an improved form of light valve or means for producing a varying light or illumination of the type in which gratings are employed.

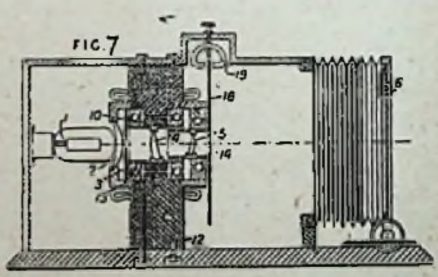


Two gratings are used, each consisting of thin glass plates ruled with finely-spaced black lines (50 to 500 lines to the inch). Fig. 2 shows a front, and Fig. 3 a side, view of the arrangement. In Fig. 2, the micrometer screws (13, 14) allow of fine adjustment of the non-moving plate (11). The other plate, which is mounted close behind the first, is given parallel motion, *i.e.*, motion vertically in its own plane, being actuated by the telephone diaphragm. In a modified form, both plates may be made to move by means of electro-magnets as indicated in Fig. 4.

Suppose that in their initial positions the plates are arranged so that the ruled lines or gratings on one, are inclined at a very small angle relatively to the lines on the other, and the two plates are then made to move behind one another. Transmitted light will appear in the form of transparent spaces alternating with black or opaque bands in the form shown in Fig. 5. In use the two plates are set to provide comparatively broad black bands and the movement of the black bands is used to cover and uncover the source of light and thereby provide the varying illumination required.

A further modification utilises a glass cell with vertical and parallel sides, opposite sides being ruled as gratings as before. This cell (Fig. 6) is filled with nitro-benzine, so that on applying an electro-magnetic or electro-static stress the refractive index of the liquid is varied. Thus the beam of light falling on one wall of the cell is bent or refracted in accordance with the electric field applied to the cell and a varying quantity of light is delivered from the opposite wall of the cell.

Patent No. 290,245.—*Westinghouse Electric and Manufacturing Co.* Convention date, May 11th, 1927.—In an exploring device for television transmitters and receivers, the exploring pencil passes through two prisms which rotate at different speeds, so that the beam traces out a spiral path. Fig. 7 shows the receiver in which the fluctuating light from a lamp (1) is collimated by a lens (2), and passes through a mask (3) and prisms (4, 5) to a viewing screen (6), the position of which is adjustable. The prisms (4, 5) may have convex surfaces, as shown, or plane surfaces, additional lenses being used in the latter case. The prisms are rotated at high speed, the prism (4) being mounted inside the rotor (10) of an induction motor having a stator (12). The prism (5) is rotated at



a slower speed by the magnetic drag exerted on the steel cylinder (14), which carries it, by the steel cylinder (13) forming part of the rotor; its speed being regulated by means of the adjustable magnetic brake (18, 19). The scanning pencil of light consequently traces out on the screen (6) a spiral path of varying luminosity.

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.

* * *

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

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September, 1928.

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Address ______________________

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